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Tertiary Mammals of Saskatchewan
Part II: The Oligocene Fauna, Non-Ungulate Orders

Loris S. Russell

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LORIS S. RUSSELL

Tertiary Mammals of Saskatchewan
Part II: The Oligocene Fauna, Non-Ungulate Orders

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Tertiary Mammals of Saskatchewan
Part II: The Oligocene Fauna, Non-Ungulate Orders

Abstract

This paper describes the mammalian fauna of the Lower Oligocene Cypress Hills Formation of Saskatchewan, except for the orders Perissodactyla and Artiodactyla. Specimens studied are in the Royal Ontario Museum, the National Museum of Natural Sciences, and the Saskatchewan Museum of Natural History. Three species of marsupials, four insectivores, two lagomorphs, 14 rodents, and 11 carnivores are described. One new species of *Nanodelphys*?, three of *Prosciurus*, one of *Ischyomys*, one of *Cylindrodon*, two of *Adjidaumo*, and one of *Eumys* are defined.

Introduction

Part I of this series, dealing with the Eocene fauna (Russell, 1965), included a general account of the mammal-bearing Tertiary deposits of Saskatchewan. The present Part II deals with the orders Marsupialia, Insectivora, Lagomorpha, Rodentia, and Carnivora of the Oligocene fauna from the Cypress Hills Formation. Part III will discuss the orders Perissodactyla and Artiodactyla, and the correlation, palaeoecology, and taphonomy of the fauna. The Miocene mammalian fauna from the Wood Mountain Formation will be described in Part IV by John E. Storer.

Distribution of the Cypress Hills Formation

All Oligocene mammals thus far found in Saskatchewan were obtained from the Cypress Hills Formation, which, as the name implies, is typically developed in the Cypress Hills of southwestern Saskatchewan and adjacent Alberta. The characteristic gravels and sands of this formation underlie the summits of plateau-like uplands, the main parts of which are four in number. The westernmost upland is large, and extends from the west end ("Head of the Mountain") in Alberta to the valley of Battle Creek near Fort Walsh, Saskatchewan. Next east is a smaller area between Battle Creek valley and Oxarart Creek "gap", partly dissected by Adams Creek. East of Oxarart Creek is another small area, mostly within Cypress Hills Provincial Park, and bounded on the east by Belanger Creek valley. The eastern-

most summit area is large, and extends from Belanger Creek to the valley of Swift Current Creek. Unlike the more westerly uplands, this easternmost portion is well settled, and farming, rather than ranching, is predominant. Small areas of Cypress Hills sediments, possibly reworked, occur at lower elevations south of the hills, especially around Cypress Lake and Palisade Gap. Northeast of the Cypress Hills is another upland, the Swift Current plateau, which is also capped by sandstones and conglomerates of Cypress Hills type.

Geology

Characteristic features of the Cypress Hills Formation have been described by a number of authors (McConnell, 1885; McLearn, 1928; Williams and Dyer, 1930; Furnival, 1946; Russell, 1950; Vonhof, 1965). The following is a summary of these and more recent observations.

The characteristic rock in the eastern, fossiliferous portion of the formation is a coarsely conglomeratic, buff-coloured sandstone, with cobbles averaging 5 to 15 cm in diameter but in some examples reaching boulder size of 30 cm or more. Most of these coarse phenoclasts are of quartzite, light grey to amber-yellow in colour, but there is some darker chert. Occasional limestone cobbles occur, some with remnants of Palaeozoic fossils. The sand component is medium to coarse grained, and consists mostly of iron-stained quartz. Hardness varies from unconsolidated to concrete-like. Both calcareous and siliceous cement have produced induration. Where free of coarser material, sand deposits exhibit pronounced cross-bedding, with fine bands of yellow and rusty brown. Fine yellowish silts and silty clays also occur. There is at least one occurrence of bentonitic silt, with beds of reworked bentonite.

Distribution of the various types of sediments is extremely irregular. Hard beds pass laterally into soft, and conglomerates merge into fine sandstones. Stratigraphic sections measured a few hundred feet apart may differ strikingly in sequence. Numerous diastemata may be seen in freshly exposed sections. Usually the lowermost strata, resting on Ravenscrag or older rocks, consist of indurated conglomeratic sandstone. Where the contact is concealed by soil, its presence may be recognized by the occurrence of springs. Water from these springs is cold and relatively low in dissolved mineral matter.

Deposition of the Cypress Hills sediments mostly occurred in streams, which in places reached a high velocity, as do those of the Alberta foothills today. Backwaters and flood plains received the finer sediments; the presence of cross bedding suggests that temporary lakes were common. Source of the sediments was to the southwest, in the newly uplifted mountains of Beltian and Palaeozoic rocks. The stream gradients over which the coarse sediments were transported some 200 miles must have been much steeper than those of present-day prairie rivers.

The lower elevation of the Cypress Hills conglomerates to the south and northeast of the Cypress Hills suggests that there were marked irregularities in the land surface on which the sediments were deposited. However, Von-

hof (1965) regarded such occurrences as the result of redeposition following erosion of the original deposits.

History of Collecting

Fossil vertebrates in the Cypress Hills rocks were discovered by R. G. McConnell in 1883, who described the occurrence in 1885. T. C. Weston, a collector for the Geological Survey of Canada, prospected the eastern Cypress Hills for fossils in 1883, 1884, 1888, and 1889. His collection of 1883 was lost in the sinking of a ship on Lake Superior. The combined collections of McConnell and Weston were described by Cope (1891). In 1904 Lawrence Lambe collected in the Cypress Hills and published an excellent account of the fauna in 1908. After Lambe's time collecting was desultory for some years. W. E. Cutler made a representative collection for the British Museum (Natural History). M. Y. Williams, C. M. Sternberg, F. H. McLearn, and L. S. Russell obtained specimens in the 1920s and 1930s. Local residents, notably H. S. Jones of Eastend and E. C. Neese of Shaunavon, made creditable collections.

A new chapter in fossil collecting in the Cypress Hills was begun by Fenley Hunter, an amateur palaeontologist from Flushing, Long Island. Folowing a recommendation by me, Mr. and Mrs. Hunter, accompanied by A. C. Silberling of Harlowton, Montana, went into the eastern part of the Cypress Hills at their own expense in 1936 to collect for the National Museum of Canada. The Hunter expeditions of 1936 and 1937 made many interesting discoveries, but their most important contribution was the location and exploitation of a site that Mr. Hunter named the Hazel Quarry but which is usually referred to as the Hunter Quarry. Mr. Hunter and his associates were the first to excavate a fossil *bed* in the Cypress Hills. Previous collectors were content to gather specimens already exposed on the surface. In justice to them it should be noted that the Hunter Quarry is unique so far, for it is the only Cypress Hills site where large-scale excavations have produced worthwhile results.

The Hunter Quarry was subsequently worked by parties from the Royal Ontario Museum of Palaeontology, directed by me in 1939, and by L. Sternberg in 1948 and 1949. In 1951 an expedition under my direction from the National Museum of Canada obtained good results here, as did a party under G. E. Lindblad in 1952. Collectors from the Saskatchewan Museum of Natural History in Regina, notably B. A. McCorquodale and Albert Swanston, worked the Hunter site in 1950, 1951, and 1953. H. S. Jones obtained here a representative collection, which is displayed in the Eastend High School along with his other finds.

In 1967 Dr. R. D. Weigel, Illinois State Normal University, and Dr. J. A. Holman, Michigan State University, made an important collection of the small faunal elements from various localities. The most recent collector in the Cypress Hills was Dr. A. G. Edmund, Curator of Vertebrate Palaeontology in the Royal Ontario Museum. In 1967 Dr. Edmund reopened the Hunter Quarry and extended it northward, using excavating machinery and explosives. His work, continued in 1968, brought together the largest and

best preserved collection of fossils so far assembled from the Cypress Hills Formation. Undoubtedly there is still good material in the hillside, waiting for future collectors, but to reach it will require a large-scale operation to remove the slump and overburden.

Localities

HUNTER QUARRY

As noted above, this is the richest single locality for Cypress Hills vertebrates, having yielded more and better specimens than all the other localities together. The original site, worked by Fenley Hunter in 1936 and 1937, is on the east side of Calf Creek valley, near the western margin of section 8, township 8, range 22, west of the 3rd meridian. This site is almost exactly one-quarter of a mile north of the southwest corner of the section. Later expeditions extended the workings south and north of the original site. The fossil-bearing beds are 60 feet above the floor of the valley, which coincides here approximately with the base of the formation. A detailed account of the occurrence was given by Russell (1940, p. 89).

LOCALITY 117 (HUNTER)

This is a bare hillside northwest of the Hunter Quarry, on the west side of the valley, and is on the eastern edge of sec.7, tp.8, rge.22, W 3rd M. It was here that Mrs. Hunter discovered the skull of *Hemipsalodon grandis* (Russell, 1938). Numerous small teeth and bones were obtained here by the Saskatchewan Museum of Natural History, using mechanical screening methods.

LOCALITY 115 (HUNTER)

This locality number was applied to specimens obtained from the east side of Calf Creek valley, about 500 feet northeast of the Hunter Quarry. The fossils occur at various levels.

WEST BRANCH CALF CREEK

Numerous exposures of sandstone and conglomerate occur on the north side of this valley, in sec.6, tp.8, rge.22, W 3rd M. Teeth and bones, mostly of brontotheres, occur here, and one incomplete brontothere skull was collected in 1951 for the National Museum of Canada.

ROYAL ONTARIO MUSEUM LOCALITIES

The recent advent of souvenir hunters and curio seekers in the Cypress Hills caused me to reconsider the former practice of giving precise locality data for all fossil occurrences. There is no point in trying to keep confidential the locality data that have been published previously, but the localities worked by the Royal Ontario Museum expeditions of 1967 and 1968 are designated by code numbers, of which the following appear in the present report: ROM V-37, V-38, V-39, V-40, V-41, V-42, V-43, V-44. Full information on

these localities will be furnished to *bona fide* palaeontologists on request to the Department of Vertebrate Palaeontology, Royal Ontario Museum.

ANXIETY BUTTE

This is a conspicuous promontory on the northwest side of Swift Current Creek valley and west of South Fork railway station.The butte received its name in the early days of settlement in reference to an apprehensive homesteader who lived nearby. The summit is in the SE ¼ of sec.28, tp.7, rge.21, W 3rd M. Numerous specimens in the Jones collection at Eastend came from this site. The specimens recorded by Lambe (1908) as from "East End Post Office" probably came from Anxiety Butte, as the original site of the North-West Mounted Police post of East End was situated near the base of the hill.

LAC PELLETIER

This is the name of a village on the south side of the Swift Current Plateau, in tp.11, rge.14, W 3rd M. Good exposures of sandstone and conglomerate occur along the rim of a large valley west and south of the village, as was mentioned in Part I of this series (Russell, 1965, p.7). The upper beds have yielded teeth and bones similar to those found in the Cypress Hills localities, but more collecting is needed to establish the stratigraphic range of the fauna.

Institutional Abbreviations

Following the practice of Part I, abbreviations are used to indicate the institution to which specimens and catalogue numbers pertain. These abbreviations are as follows: AMNH, American Museum of Natural History; CM, Carnegie Museum of Pittsburgh; NMC, National Museum of Natural Sciences (Vertebrate Palaeontology); ROM, Royal Ontario Museum; SMNH, Saskatchewan Museum of Natural History.

Systematic Description

Order Marsupialia
Family Didelphidae
Genus *Peratherium* Aymard, 1850
Type species: *Didelphis elegans* Aymard, 1846

GENERIC CHARACTERS

Small didelphids with dentition closely resembling that of *Didelphis* but differing in that P_2 does not exceed P_3 in size, the M^{1-3} have the paracone smaller than the metacone but still distinct, the metaconule present, the protoconule vestigial, stylar cusp B small or vestigial, stylar cusp C large, the M_{1-3} with hypoconulid close to or at the posterolingual angle of the crown, almost directly posterior to the entoconid.

***Peratherium valens* (Lambe)**

Fig. 1A-E.

REFERENCE

Didelphys valens, Lambe, 1908, pp. 22, 23, pl. 8, figs. 1–7.

TYPE. NMC 6249, right M^1 or M^2, from "Bone Coulee", collected by L. M. Lambe, 1904.

REFERRED SPECIMENS. NMC: 9125, 9140, upper molars; 9126, right M_4. ROM: 1809, 1810, 1811, 6222, 6223, 6224, 6225, 6226, upper molars; 1812, 1813, 6234, 6235, 6236, 6237, 6238, 6239, 6240, 6241, lower molars. From various localities in Calf Creek and Conglomerate Creek valleys.

SPECIFIC CHARACTERS

Molar teeth relatively large for the genus; in upper molars, stylar cusp B small or absent, metaconule moderately developed to obscure, posterolabial angle of crown in M^{1-3} only moderately produced; lower molars with trigonid slightly inclined anterad, hypoconulid on M_{1-3} set in slightly from directly behind entoconid, on M_4 it is medially situated and projects posterad.

DESCRIPTION

The type specimen clearly represents the genus *Peratherium*, as shown by the relatively prominent, V-shaped paracone. Stylar cusp A is present, cusp C is as large as the paracone, but cusp B is represented by a curved row of three very small cuspules anterior to cusp C. The small but distinct metaconule was described by Lambe (1908) as a hypocone. Dimensions: anteroposterior, 2.01 mm; transverse, 2.03 mm.

Additional upper molars in the NMC and ROM collections vary in size as compared with the type, the majority being slightly smaller. These specimens also differ from the type, and among themselves, in the degree to which the protoconule is developed. In some examples there is a vestige of the protoconule, and a small but distinct stylar cusp B attached to cusp C.

Lambe described as a paratype NMC 6250, and interpreted it as a complete tooth, but it is only the trigonid of a lower molar. The metaconid is

broken but was larger than the anteriorly inclined paraconid. The transverse dimension is 1.25 mm.

The numerous complete lower molars now available show that the protoconid is the highest cusp of the trigonid, the metaconid lower, and the paraconid the lowest. In the talonid of lower molars other than M_4, the hypoconulid is situated almost but not quite directly posterior to the entoconid and so does not form the posterolingual angle of the crown, but the posterior margin is nearly straight and transverse. On M_4, in contrast, the hypoconulid is almost in the midline of the tooth, and projects posterad, giving the posterior margin of the crown an angulate rather than straight outline. On this tooth the talonid is distinctly narrower than on the other lower molars. Dimensions: right lower molar, probably M_2 (ROM 1812), anteroposterior, 2.13 mm, transverse, 1.25 mm; right M_4 (NMC 9126), anteroposterior, 1.97 mm, transverse, 1.12 mm.

REMARKS

Cope (1884, p. 793) distinguished *Peratherium* from *Didelphis* on various dental features and on the absence of the inflected mandibular angle. The latter supposed characteristic is demonstrably untrue for European species of *Peratherium* but was accepted by Scott (1941, p. 961) and Lavocat (1951, p. 7) as a possible distinction of American species. The absence of a feature that is almost universally characteristic of marsupials seems highly improbable in forms that are otherwise typically didelphid, and in fact Simpson (1928, p. 7) and Hough (1961, p. 222) described American species with strongly inflected angles. The latter author, however, retained the generic name *Herpetotherium* Cope for those species in which the angle was almost or quite uninflected. Until the presence of such a distinctive feature among Tertiary didelphids is more clearly demonstrated, it seems proper to refer all species based on dentitions only to *Peratherium*.

Genus *Nanodelphys* McGrew, 1937
Type species: *Nanodelphys minutus* McGrew, 1937

GENERIC CHARACTERS

"M^2 and M^3 possess the following characters: median stylar cusp [C] absent; stylar cusp B prominent; paracone and metacone subequal; external shelf bilobate; paracone and metacone in middle of transverse diameter of tooth; size small." (McGrew, 1937, p. 452).

Nanodelphys? *mcgrewi*, sp. n.

Fig. 1F.

ETYMOLOGY

Named for Dr. Paul O. McGrew, University of Wyoming, who has made many important contributions to knowledge of Tertiary marsupials and other mammals.

TYPE. ROM 1814, a left upper molar, probably M^2, from ROM locality V-40.

SPECIFIC CHARACTERS

Relatively large; upper M with produced posterobuccal angle, distinct protoconule, and relatively small stylar cusp B.

DESCRIPTION

The outline of the crown is roughly that of a right-angle triangle, the posterior margin forming the hypotenuse. The buccal margin is distinctly concave, the posterior margin slightly so. The posterobuccal angle of the crown is markedly produced, the anterobuccal angle slightly produced. Paracone and metacone are conoid, subequal, and situated near the middle of the crown. The buccal margin of the crown is slightly notched and bears stylar cusps, of which cusp B is prominent and cusp C present but obscure; there is a ridge joining cusp B to the paracone. The protocone is situated at the lingual extremity of the crown and is V-shaped; there is a small but distinct protoconule. Dimensions: anteroposterior, measured at right angles to anterior margin, 4.72 mm; transverse, 4.58 mm.

REMARKS

This tooth is suggestive of an insectivore molar but is regarded as didelphid because of the broadly triangular crown and the presence of stylar cusps. There are resemblances to the upper molars of *Nanodelphys minutus* McGrew from the Lower Brulé of Nebraska. These are in the conical, rather than V-shaped, form of the paracone and metacone, the presence of a distinct stylar cusp B and a smaller cusp C, the presence of a ridge connecting paracone and stylar cusp B, and the concavity of the buccal margin of the crown. Differences are the much larger size of the Cypress Hills tooth, the strong production of the posterobuccal angle, the lesser development of stylar cusp B, and the presence of a protoconule. ROM 1814 may well represent an undescribed genus of didelphid, but until more material is available, it is provisionally included in *Nanodelphys*.

Cf. *Nanodelphys minutus* McGrew, 1937, 1939

Fig. 1G.

REFERRED SPECIMEN. ROM 6242, left M^2 or M^3, from ROM locality V-37.

DESCRIPTION

This very small molar differs from the corresponding teeth of *Peratherium valens* in having the posterobuccal angle less produced, giving a more nearly symmetrical outline to the triangular crown. The protocone, as in *Peratherium*, is a V-shaped crescent directed somewhat anterad as well as linguad. Paracone and metacone are more conoid than in *Peratherium*, and the crests joining these cusps to the buccal angles of the crown are conspicuous. The buccal margin is distinctly concave, suggesting the outline of some insectivore molars, but the line is interrupted by a low but distinct mesostyle, which may represent stylar cusp C. There are no other stylar cusps. Dimensions: anteroposterior, 1.66 mm; transverse, 2.21 mm.

REMARKS

This tooth is almost identical in size with those of the type of *Nanodelphys minutus* McGrew. Other resemblances are in the concave buccal margin of the crown and the conoid paracone and metacone. The absence of stylar cusps except for the distinct mesostyle makes reference of the specimen to this genus and species questionable, but no better allocation can be made at present.

Galbreath (1953, p. 41) suggested that *Peratherium huntii* (Cope) was based on the lower dentition of *Nanodelphys,* possibly *N. minutus.* This plausible hypothesis must await the discovery of associated upper and lower dentitions for confirmation or disproof.

Order Insectivora
Family Leptictidae
Genus *Ictops* Leidy, 1868
Type species: *Ictops dakotensis* Leidy, 1868

GENERIC CHARACTERS

Size relatively large for leptictids. Premolars increasing regularly in size and in molarization posteriorly. P^3 with elongate buccal crest and prominent lingual cusp. Upper molars and P^4 basically triangular, but with prominent, posterad projecting cingular hypocone; protocone narrowly V-shaped, intermediate cuspules at ends of crests; paracone and metacone conoid, subequal, close to buccal cingulum. Lower molars typically leptictid, with high but not excessively high trigonid, subequal protoconid and metaconid, and smaller but distinct paraconid; hypoconulid in midline, projecting posterad almost as much on M_1 and M_2 as on M_3.

***Ictops acutidens* Douglass, 1901**

Fig. 1H-J; Fig. 2A-E.

REFERENCES

Douglass, 1901, p. 245; Matthew, 1903, pp. 205–207, fig.4.

REFERRED SPECIMENS. ROM: 6243, left M^2; 1815, right M^2; 1817, 6245, left M_1 or M_2; 1816, 6244, left M_3. ROM localities V-38 and V-40.

SPECIFIC CHARACTERS

Size somewhat large for the genus. Upper molars with crown narrowing abruptly linguad from paracone and metacone, so that, with protruding anterior and posterior (hypocone) cingula, crown outline appears constricted near mid-width. Lower molars with relatively small paraconid, situated near midline, and projecting somewhat anterad.

DESCRIPTION

The trigon of the upper molars is narrowly triangular, with straight arms on the V-shaped protocone crest, but the indented anterior and posterior margins of the crown give an outline differing from the subquadrate shape in *I. dakotensis* and other species. ROM 6243 differs from ROM 1815 in being

a little smaller, and in having the posterior (hypocone) cingulum bulging more prominently. Dimensions: ROM 1815, anteroposterior, 2.74 mm, transverse, 4.30 mm; ROM 6243, anteroposterior, 2.64 mm, transverse, 4.23 mm.

In the lower molars the arrangement of the trigonid cusps is almost bilaterally symmetrical, with the high, subequal protoconid and metaconid forming a posterior pair, and the nubbin-like paraconid projecting dorsad, anterad, and slightly linguad from the valley between. On the talonid the hypoconid and entoconid are subequal, and symmetrically located at the posterobuccal and posterolingual angles, respectively. The more or less protruding hypoconulid lies about half-way between. Anterior to the cusps the sides of the talonid are shallowly indented, more distinctly on the buccal than on the lingual side. ROM 6244, which is very little worn, shows a minute marginal cuspulid on the anterior slope of the entoconid. Dimensions: ROM 1816, anteroposterior, 3.00 mm, transverse, 2.12 mm; ROM 6244, anteroposterior, 2.92 mm, transverse, 2.16 mm.

REMARKS

The upper molars agree in size and in shape of crown with those of the specimen (AMNH 9604) described by Matthew (1903) as *Ictops acutidens*. The metastyle on ROM 1815 is slightly more prominent, and the hypocone shelf on ROM 6243 is larger. In species of *Ictops* other than *I. acutidens*, as known to me, the sides of the trigon are straight, or only slightly indented. Reference of the lower molars to *I. acutidens* is tentative, but the agreement in size and in the form of the paraconid indicates that they all belong to a single species. All of these Cypress Hills teeth are more suggestive of Eocene leptictids than of *I. dakotensis* of the Middle Oligocene.

Genus *Metacodon* Clark, 1936, 1937
Type species: *Metacodon magnus* Clark, 1936

GENERIC CHARACTERS

Rather small. Mandibular angle vestigial; condyle low. Lower molars with asymmetrical trigonid, the protoconid highest and the paraconid lowest, the latter situated at or close to the lingual margin; talonid of M_3 much narrower than trigonid.

REMARKS

McKenna (1960) presented much evidence to show that *Metacodon* Clark is a junior synonym of *Geolabis* Cope. Nevertheless I am inclined to accept the subsequent rebuttal of Clark (1966), who pointed out that the type species of *Geolabis, G. rhynchaeus* Cope (1884), was based on two skull fragments, without determinable teeth. Even these two fragments were not associated with certainty. Cope's genus and species, therefore, are not comparable with the taxa subsequently based on dentitions (*Metacodon* Clark and *Ankylodon* Patterson and McGrew) and may be regarded as indeterminate.

There has been much disagreement on the taxonomic disposition of *Metacodon* and related genera. In a review of the early Insectivora in preparation, I expect to show that they are leptictids, with no more than subfamily distinctiveness. Moreover, it will also be demonstrated that the Leptictidae are not closely related to the Erinaceidae (see also Butler, 1956).

Metacodon, cf. *magnus* Clark, 1936

Fig. 2F, G.

REFERRED SPECIMEN. ROM 6246, the trigonid of a left lower molar; ROM locality V-38.

DESCRIPTION

This fragment agrees closely with the corresponding part of the lower molars of *Metacodon* as described by Clark (1966) and by McKenna (1960, *Geolabis*). Particularly noticeable is the triangular outline and the antero-lingual position of the paraconid. In size the specimen is distinctly larger than the corresponding part in *M. mellingeri* Patterson and McGrew (1937) and may even exceed that for *M. magnus*, but the width of the trigonids in the latter species has not been published. Transverse dimensions of ROM 6246, 1.91 mm.

Metacodon? sp.

Fig. 2H, I.

REFERRED SPECIMEN. ROM 6374, a left M_3. Vicinity of Hunter Quarry.

DESCRIPTION

A second species of *Metacodon* or a related insectivore is represented by this specimen. It is small, about as long as the M_3 of *M. mellingeri* Patterson and McGrew (1937). The trigonid is triangular, with the posterior wall nearly vertical. The three cusps are well spaced, the protoconid largest, and the metaconid not much larger than the paraconid. The last is situated somewhat buccal to the lingual margin. The talonid is much narrower than the trigonid and tapers posterad, so that the hypoconid is terminal and almost in the midline of the tooth, lying close to the entoconid, and obscuring the hypoconulid. There is a broad, shallow, triangular valley between hypoconid and protoconid; the crista obliqua terminates against the trigonid a little closer to the metaconid than to the protoconid. A slight anterior cingulum is present adjacent to the paraconid but does not reach it. Dimensions: anteroposterior, 1.63 mm; transverse, 1.34 mm.

REMARKS

The high triangular trigonid with vertical posterior wall and the relatively large and independent paraconid are suggestive of the lower molars of *Metacodon* and its relatives. In these, however, the metaconid is distinctly larger than the paraconid. The attenuated talonid and the near-medial hypoconid are also differences from the M_3 of *Metacodon*. The length of the tooth is

about the same as in *M. mellingeri*, but the width of the trigonid is distinctly greater. It may well be that the specimen represents an undescribed genus of insectivores.

Insectivora, *incertae sedis*

REFERRED SPECIMEN. ROM 6375, a worn fragment of a left mandibular ramus with two incomplete molars. Vicinity of Hunter Quarry.

DESCRIPTION

The posterior of the two teeth is only slightly damaged. It has a moderately high triangular trigonid, with a large protoconid and a smaller, closely spaced metaconid. The paraconid is the smallest cusp but is well separated from the metaconid and is slightly inclined anterad. The talonid is little more than a posterior shelf, with no distinct hypoconid, but with a slight posterolingual angulation that could represent the entoconid. That this tooth is probably M_2 is shown by the trace of an alveolus posterior to it. The remnant of the tooth in front also bears a reduced talonid but is more rectangular, with a suggestion of a hypoconid. There are five alveoli anterior to this tooth fragment. The specimen is too delicate for caliper measurement, but the presumed M_2 is approximately 1.38 mm in length.

REMARKS

The very small talonid is suggestive of the lower molars of *Apternodus* Matthew, but those teeth are larger and have a more pointed talonid with a single cusp, and a crest anterad from it to the trigonid. In *Micropternodus* Matthew the lower molars are almost as small as ROM 6375, but there is a more normal talonid, with distinct hypoconid.

Order Lagomorpha
Family Leporidae
Genus *Palaeolagus* Leidy, 1856
Type species: *Palaeolagus haydeni* Leidy, 1856

GENERIC CHARACTERS

Relatively small leporids. Cheek teeth distinctly hypsodont. Upper molars broadly rectangular-ovoid in crown outline; unworn pattern consists of two prominent buccal cusps (parastyle and metastyle) almost confluent along buccal margin, each with an oblique internal crest which unite at a point just buccal of centre of crown, forming a median cusp and a V-shaped crest; two projecting lingual cusps (protocone and hypocone), joined in a W-shaped crest, the arms of which form the anterior and posterior rims of the crown, respectively, and the centre outlines a shallow notch in the lingual margin. With wear, the depression between the buccal margin and the median cusp becomes a small lake, which soon disappears; the crescentic valley between the median cusp and the two lingual cusps becomes a V-shaped lake, which remains to an advanced stage of wear; the lingual

notch becomes narrower but does not give off an isolated lake. P^4 molariform but broader anteroposteriorly than molars.

Lower molars with trigonid wider and shorter than talonid; lingual and buccal notches separating trigonid and talonid about equal, so that crown pattern is nearly symmetrical on the longitudinal axis; moderately worn teeth (P_4-M_2), with buccal and lingual notches on posterior margin of talonid forming a kind of hypoconulid; P_4 molariform, with subequal trigonid and talonid joined by a longitudinal crest, producing a dumb-bell-shaped outline when worn.

Palaeolagus temnodon Douglass, 1901

Fig. 3A-H; Fig. 4A, B.

REFERENCES

Douglass, 1901, pp. 14, 15; Wood, 1940, pp. 320–325, figs. 78–96; Dawson, 1958, pp. 19, 20.

REFERRED SPECIMENS. NMC: 9173, left P^3; 6486, right M^1; 9198, left mandibular fragment with P_3–M_1; 9174, left P_3; 6485, right P_4; 9175, left M_1; 6492, right $M_{1?}$; 9190, right lower molar. ROM: 6251, 6264, left P^4; 6252, left M^1; 6265, left M^2; 6259, 6260, left P_3; 6258, 6261, 6262, right P_3; 6257, left DP_3. From various localities in the valleys of Calf Creek and Conglomerate Creek.

SPECIFIC CHARACTERS

Size slightly larger than that of *P. haydeni* Leidy. Cheek teeth relatively low crowned, with cement absent or confined to valleys. P^2 consisting of three anteriorly directed, diverging lobes, the buccal lobe small but persistent. P^3 with poorly developed anterior crest. P^4–M^2 with shallow lingual notch (hypostria) that becomes compressed and deep with crown wear, usually remaining simple but giving off a small circular lake on some teeth; median crescentic lake retaining a nearly symmetrical V-shape through most of wear; buccal lake disappearing at an early stage of wear. Slightly worn P_4–M_2 have distinct hypoconulids, set off from main part of talonid by buccal and lingual notches, but other specimens referred to this species have simple talonids.

DESCRIPTION

The P^3 (NMC 9173) is ovoid in crown outline, with the anterobuccal corner, as it were, cut away. This opens the external lake to form a narrow, oblique re-entrant. There are no external roots. Dimensions: anteroposterior, 1.91 mm; transverse, 2.90 mm.

ROM 6264 is identified as a P^4 because of the broadly quadrate outline of the crown. It could be a DP^4. The lingual cusps are prominent, with a rounded notch between. The central cusp is distinct but slightly damaged. The crest that connects this cusp with the buccal cusps is compressed anteroposteriorly, with the anterior branch heavier than the posterior. The buccal margin of the crown is a continuous ridge, and the re-entrant is isolated as a

narrowly ovoid lake. Dimensions: anteroposterior, 1.82 mm; transverse, 3.10 mm.

The tooth identified as a left M^1 (ROM 6252) is of special interest because of the almost unworn crown. It is not as wide buccolingually as the other upper molars, but the proportions might have changed with further wear. The central cusp is situated almost in the centre of the crown, just in advance of midlength. The V-shaped crest, of which this cusp is the apex, has a curved anterior arm and a slightly longer, sinuous posterior arm. The two buccal cusps are bulbous, but the anterior one has an excavated summit. These two cusps almost fuse at the midpoint of the buccal margin, thus almost closing a triangular valley between the cusps and the central crest. The anterior and posterior margins of the crown are elevated rims, the anterior one slightly worn. On the lingual side the two marginal cusps form bulges, and are separated by a shallow re-entrant, the point of which is slightly in advance of midlength. The anterior cusp (protocone) is thus narrower than the posterior (hypocone) but extends farther into the crown, so that the valley between it and the central crest is narrow. The posterior lingual cusp (hypocone) is more linear and continues into the posterior margin of the crown. The valley between this rim and the posterior arm of the central crest is wide and deep. Dimensions: anteroposterior, 2.09 mm; transverse, 3.04 mm.

NMC 6486 was described and figured by Lambe (1908, pp. 58, 59, pl. 8, fig. 21) as the M^1 of *Palaeolagus haydeni* and was refigured by Wood (1940, fig. 93). Compared with ROM 6252, it shows how the crown pattern of the upper molars was changed by moderate wear. The broad crescentic valley between the central crest and the lingual cusps has become a V-shaped lake. The central cusp and crest are still distinct, but the valley between them and the buccal cusps has become a a slit-like lake, with denticulations on the buccal margin. The buccal cusps have become confluent to form a massive external rim, but the hollow on the apex of the anterobuccal cusp (parastyle) is still visible. There are two vestigial buccal roots at the tip of the main lingual root. Dimensions: anteroposterior, 2.08 mm; transverse, 3.12 mm.

A deeply worn tooth (ROM 6265), identified as a left M^2, has a more narrowly ovoid crown outline, with the buccal margin posterolingually oblique. The lingual re-entrant is long and straight, penetrating almost to the centre of the crown. The central lake has been reduced to a narrow, slightly curved slit, which is slightly oblique to the line of the lingual re-entrant. There is a vestigial root on the posterobuccal angle of the crown, at about half the height of the tooth as preserved. Dimensions: anteroposterior, 1.85 mm; transverse, 3.12 mm.

A right upper molariform tooth (NMC 9120) is of interest because of its small size and extreme degree of wear. The outline of the crown is distinctly ovoid. The lingual re-entrant is narrow and deep and almost reaches the central lake, which has been reduced to a buccolingual slit. There is a short, oblique re-entrant from what is taken to be the posterobuccal margin. Because of the narrowly ovoid outline of the crown, this tooth is thought to be M^2, an identification supported by the arcuate curve of the tooth in the vertical axis. If buccal roots were present, they have been worn away. Dimensions: anteroposterior, 1.85 mm; transverse, 2.95 mm.

Turning to the lower dentition, there are at least six examples of isolated P_3 in the collections. All are worn, and the crown pattern has been reduced to an anterior and a posterior ovoid area, joined by a narrow commissure in the longitudinal midline. This creates a dumb-bell-shaped pattern for the occlusal surface. The marginal grooves that divide the anterior from the posterior part of the tooth extend down the sides of the crown, that on the buccal side much farther than that on the lingual side.

A P_3 that is only slightly worn is seen on NMC 9198, which is a left mandibular fragment with P_3–M_1. On the P_3, the anterior portion, corresponding to and resembling a trigonid, is narrower than the posterior part (talonid). There are two low but distinct cusps, analogous to protoconid and metaconid, with the shallow valley between extending onto the anterior face of the crown. Although separated by buccal and lingual re-entrants, the anterior and posterior parts of the crown are more confluent than in worn teeth. The posterior part is more worn but clearly shows the tripartite division into hypoconid, hypoconulid, and entoconid. However, the marginal sulci that separate these three parts do not extend down the sides of the tooth much below the present level of wear, which explains why the divisions are not seen on worn teeth. On the two molariform teeth the trigonid is higher than the talonid and is relatively narrow, with moderately convex anterior margin and broadly angulate posterior margin. Besides being lower than the trigonid, the talonid is longer and narrower and exhibits the same tripartite form as the P_3, with sulci separating the hypoconid, hypoconulid, and entoconid. As on the P_3, these sulci are short, and only a little more wear on the specimen would have obliterated the tripartite pattern of the talonid. Because the sulci are a little wider and deeper on the P_4 than on the M_1, they would have persisted longer on the former tooth. Dimensions at triturating level: P_3, anteroposterior, 1.60 mm, transverse, 1.57 mm; P_4, anteroposterior, 1.95 mm, transverse, 2.1 mm; M_1, anteroposterior, 2.20 mm, transverse, 2.25 mm.

A right P_4 (NMC 6485) was described and figured by Lambe (1908, pp. 58, 59, pl. 8, figs. 24, 25). Although the crown is still high, wear has obliterated the tripartite pattern of the talonid. In other respects it resembles the P_3 of NMC 9198. A similar stage of wear in lower molars is shown by NMC 6492 and 9175. NMC 9176, a right M_2, still retains a trace of the tripartite form of talonid. It is thus clear that this feature, listed among the diagnostic characters of the species, will not be present on well-worn lower cheek teeth.

The only tooth in the collection that can be identified positively as deciduous is ROM 6257, a left DP_3. The crown is moderately worn and tapers from posterior to anterior. It is divided into three parts. The main part is in the middle, and consists of two forward-projecting cusps, analogous to protoconid and metaconid, joined by a V-shaped crest. Anterior to this, and fitting into the notch of the V, is a separate, ovoid cusp, analogous to a paraconid. The posterior portion or talonid is a narrow ovoid shelf, projecting slightly buccad, and showing no trace of the tripartite division of the posterior margin. In lateral view the crown is seen to be low, extending only a little below the base of the cusps, and with well-defined anterior and posterior roots. Dimensions: anteroposterior, 2.33 mm; transverse, 1.41 mm.

REMARKS

Lambe (1908) referred his specimens to *Palaeolagus haydeni*. In an earlier revision (Russell, 1934, p. 57) I classified them as probably representing *P. temnodon*. Wood (1940) more or less agreed with this opinion. Subsequently I had the opportunity to examine types and topotypes of *P. temnodon* in the Carnegie Museum and the American Museum of Natural History and found that the Cypress Hills specimens agree closely in size and structure with corresponding teeth from the Lower Oligocene of Pipestone Springs, Montana. The resemblances in the upper dentition seem definite enough to warrant positive reference of the Cypress Hills specimens to *P. temnodon*. The distinction between lower teeth of *P. temnodon* and *P. haydeni* is not so clear-cut, and the assignment of the Cypress Hills specimens must remain somewhat inferential until the upper and lower dentitions of a single individual are found in association.

The structure of the relatively unworn M^1 (ROM 6252) is of some interest in connection with the problem of cusp homologies in the lagomorph upper molar (see Wood, 1940, pp. 351–355). In a study of this problem (Russell, 1959) I emphasized the importance of the central cusp, and this is confirmed by the above-mentioned specimen. However, I no longer subscribe to the concept of the amphicone or parametacone and regard the central cusp of pantotheres, and by analogy of lagomorphs, as more likely the equivalent of stylar cusp C of didelphids. If the lingual cusps represent protocone and hypocone, then in this interpretation there are no cusps in the lagomorph upper dentition corresponding to paracone and metacone. On the other hand, the lingual cusps may be the paracone and metacone, the protocone and hypocone being absent.

Genus *Megalagus* Walker, 1931
Type species: *Palaeolagus turgidus* Cope, 1873

GENERIC CHARACTERS

Somewhat larger than *Palaeolagus*. Cheek teeth less hypsodont. P^2 with buccal lobe minute or absent. P^3 submolariform. Upper molariform teeth (P^4–M^2) relatively narrow anteroposteriorly, with distinct buccal roots; lingual re-entrant disappearing with moderate wear, leaving at most only a small lake; central crescentic lake persistent, with anterior arm usually longer, and in some examples opening near anterobuccal angle of crown; buccal cusps close together; buccal lake disappearing with slight wear. P_3 with protoconid well in advance of metaconid, so that worn teeth do not show dumb-bell pattern. On P_4–M_2 the buccal sulcus between trigonid and talonid is distinctly wider and deeper than the lingual sulcus, so that the talonid is not symmetrical on the longitudinal axis of tooth; hypoconulid projection disappears with slight wear, leaving hypoconid and entoconid angle closer to posterior margin than to trigonid.

Megalagus brachyodon (Matthew, 1903)

Fig. 4C-I, Fig. 5A-C.

REFERENCES

Palaeolagus brachyodon, Matthew, 1903, pp. 217, 218; *Megalagus brachyodon*, Wood, 1940, pp. 343, 344, figs. 106–110; Dawson, 1958, p. 10.

REFERRED SPECIMENS. NMC: 9119, left M^1; 9180, right M^1; 6483, incomplete left mandibular ramus with P_3–M_2; 9177, 9178, right P_4; 9181, left M_1; uncatalogued left M_1 or M_2. ROM: 6270, left P^3; 6271, left P^4; 6267, left M^1; 6266, right M^1; 6274, right M^2; 6376, left mandibular fragment with P_4 and M_1; 6269, left M_1. Various localities in Calf Creek and Conglomerate Creek valleys.

SPECIFIC CHARACTERS

Upper molariform teeth less hypsodont than in *M. turgidus*, and wider buccolingually, so that the crown appears relatively compressed anteroposteriorly.

DESCRIPTION

The left P^3 (ROM 6270) shows considerable wear. The outline of the crown is roughly triangular, with the posterior margin forming one side and the converging anterior and buccal margins the other two sides. The internal crescent is long and sinuous; the external lake is small and slit-like and is almost parallel to the long axis of the tooth row. The central part of the crown, between crescent and lake, is a low prominence. An even more prominent part is the area posterobuccal to the external lake. Neither of these prominences is a distinct cusp. Dimensions: anteroposterior, 2.80 mm; transverse, 4.18 mm.

The left P^4 may be represented by ROM 6271, as it is very similar to that tooth in the type of the species, although somewhat smaller. The worn crown shows only a small, centrally located crescent, symmetrically U-shaped. Dimensions: anteroposterior, 2.33 mm; transverse, 3.93 mm.

Three teeth represent M^1. NMC 9180, from the right side, has a narrowly ovoid outline. Buccal and lingual re-entrants are absent, but there are vestiges of the two buccal cusps. The central crest is located closer to the posterior than to the anterior margin; the posterior arm is distinctly longer than the anterior. ROM 6266, also a right M^1, has the buccal and lingual margins slightly less rounded, with vestiges of the re-entrants. The central crest is asymmetrical, as in ROM 9180, but is about equidistant from anterior and posterior margins. ROM 6267, a left M^1, also has flattened buccal and lingual margins, with faint re-entrants. The posterior margin near the lingual end is slightly concave. The central crescent is more nearly symmetrical than in the other two M^1 and is slightly posterior to midlength. Unlike the other two M^1, this specimen has the buccal roots poorly developed. Dimensions: NMC 9180, anteroposterior, 2.32 mm, transverse, 4.12 mm; ROM 6266, anteroposterior, 2.57 mm, transverse, 4.68 mm; ROM 6267, anteroposterior, 2.62 mm, transverse, 5.21 mm.

A somewhat different structure is shown by NMC 9119, which may be a left M^1. The crown is smaller and relatively broader than in the three teeth described above. There are vestiges of re-entrants, the one on the buccal side being broad, and the marginal bulge behind it being prominently angulate. The central crescent is located slightly posterior to midlength, and the posterior arm is longer than the anterior. There is a tiny circular lake just lingual to the crescent. Dimensions: anteroposterior, 2.08 mm; transverse, 3.45 mm.

ROM 6274 is a well-worn right M^2. The anterior margin of the crown is more convex than the posterior, giving a slightly arcuate outline. The buccal margin is oblique. There is a vestigial lingual re-entrant. The central crescent has become divided into two separate arms: the anterior opens through the rim of the crown at the anterobuccal angle; the shorter, posterior arm does not reach the crown margin, but there is a rounded lake buccal to it which opens narrowly at the posterobuccal angle. Lingual to the two arms is a rounded central lake. The buccal roots are distinct. Dimensions: anteroposterior, 2.57 mm; transverse, 4.74 mm.

NMC 6483 is the incomplete mandibular ramus mentioned and figured by Cope (1891, p. 5, pl. 14, figs. 9, 9a). The incisor is represented by a portion showing ventrally through a break in the alveolar wall. P_3 is badly broken, retaining only a remnant of the crown. P_4 to M_2 are essentially intact. They show the distinctive talonid of the genus, with the wide and deep groove separating it from the trigonid on the buccal side, whereas the lingual side is a posterior continuation of the trigonid. None of these teeth shows the hypoconulid, which would have been present at an earlier stage of wear. The M_3 is represented by the empty alveolus. Dimensions: P_4, anteroposterior, 3.34 mm, transverse (at trigonid), 3.51 mm; M_1, anteroposterior, 3.20 mm, transverse (at trigonid), 3.37 mm; M_2, interoposterior, 3.30 mm, transverse (trigonid as preserved) 3.09 mm.

Another fragment of a left mandibular ramus (ROM 6376) retains P_4 and M_1, with alveoli for P_3 and M_2. It is distinctly smaller than NMC 6483, and the teeth have the lingual sulcus between trigonid and talonid better defined. The talonid has the asymmetrical form characteristic of *Megalagus*, and the size is not much less than the minimum dimensions published by Wood (1940, p. 344) for *M. brachyodon*. Dimensions: P_4, anteroposterior, 2.14 mm, transverse (at trigonid), 2.35 mm; M_1, anteroposterior, 2.42 mm, transverse (at trigonid), 2.37 mm.

The lower teeth in the NMC collection (NMC 9177 and 9178) are identified as P_4 because the talonid is about the same dimension anterposteriorly as the trigonid, and because the anterior and posterior line of crown and root are parallel and about at right angles to the triturating surface. In contrast, two other NMC *specimens* (9181 and an uncatalogued tooth) have the talonid distinctly wider anteroposteriorly than the trigonid and the posterior face of the tooth curving ventrad and posterad, so that the plane meets the triturating surface at an obtuse angle, and the anterior and posterior roots diverge. These features indicate M_1 or M_2. In size these four teeth are equal to, or slightly smaller than, the corresponding teeth of NMC 6483 and distinctly larger than ROM 6376.

REMARKS

The mandibular fragment, NMC 6483, was referred by Cope (1891) and Lambe (1908) to *Palaeolagus turgidus* (now *Megalagus turgidus*). But Lambe admitted uncertainty as to the distinction between lower teeth of *P. turgidus* and *P. brachyodon*. Matthew (1903), in his description of *P. brachydon*, included the reported *P. turgidus* of the Cypress Hills fauna in the synonymy of his new species. Wood (1940, p. 340) seems to have overlooked the mandibular fragment (NMC 6483) but suggested that the species of *Megalagus* in the Cypress Hills probably represented *M. brachyodon* rather than *M. turgidus*. The upper molariform teeth more recently obtained from the Cypress Hills Formation agree closely with those of Matthew's holotype of *M. brachyodon* (AMNH 9652). *M. turgidus* has not yet been reported from Lower Oligocene beds, and for this reason the lower as well as the upper teeth in the Cypress Hills fauna are referred to *M. brachyodon*.

The genus *Megalagus* was established by Walker (1931, p. 234) to recognize the important differences between *Palaeolagus turgidus* Cope and *Palaeolagus haydeni* Leidy. Wood (1940, p. 332) revised Walker's genus and included *P. brachyodon* Matthew. Dawson (1958, p. 70) regarded *Megalagus* as an aberrant side branch of late Eocene age and *Palaeolagus* as the progressive leporid, leading to the leporines. I cannot reconcile this view with the seemingly precocious hypsodonty of *Palaeolagus* and the less specialized teeth of *Megalagus*. There seems to be no structural condition that excludes *Palaeolagus* as well as *Megalagus* from being derived from *Mytonolagus* of the Late Eocene. For a comprehensive view of lagomorph history, see Dawson (1967).

Order Rodentia

REMARKS

In the following descriptions of rodent teeth, the nomenclature used is that of Wood and Wilson (1936), slightly modified.

Family Paramyidae Miller and Gidley, 1918
Genus *Prosciurus* Matthew, 1903
Type species: *Prosciurus vetustus* Matthew, 1903

GENERIC CHARACTERS

Upper molars with a continuous crest formed by the anteroloph, protocone, hypocone (if present), and posteroloph. Protocone prominent; hypocone, if present, barely separated from protocone. Paracone connected to protocone crest by protoloph; metaloph variable, usually connecting metacone and metaconule but not reaching protocone crest; valleys between anteroloph and protoloph and between metaloph and posteroloph simple or with one or more cross crests. Upper fourth premolar similar to molars but parastyle distinct and projecting anterad. Lower molars rhombic in outline, broadly and shallowly basined; metaconid prominent, projecting antero-

linguad; anterolophid connecting protoconid and metaconid; posterior arm of protoconid curving linguad towards metaconid but not quite reaching it; distinct mesoconid connected by the ectolophid to the hypoconid and in some specimens to the posterior arm of the protoconid; entoconid usually connected by the hypolophulid between mesoconid and hypoconid; posterolophid usually distinct from hypolophulid and entoconid. Lower fourth premolar with talonid similar to that of molars but protoconid and metaconid close together, so that outline of tooth is triangular rather than rhombic.

Prosciurus saskatchewensis (Lambe)

Fig. 5D-I; Fig. 6A-G.

REFERENCES

Sciurus? saskatchewensis, Lambe, 1908, p. 55, pl. 8, figs. 16, 17; *Prosciurus saskatchewensis*, Russell, 1934, pp. 56, 57; Wood, 1937, p. 169, fig. 17.

TYPE. NMC 6479, right P^4; "Bone Coulee", Lambe, 1908.

REFERRED SPECIMENS. NMC: 9170, left M^1; 9132, right M^1; 9133, left M_2. ROM: 6276, left P^4; 6280, left M^1; 6277, left M^1 or M^2; 6281, right M^1; 6282, right M^3; 1822, right P_4; 1823, left M_2; 6278, right M_3. Various localities in Conglomerate Creek and Calf Creek valleys.

SPECIFIC CHARACTERS

Upper fourth premolar and molars with relatively simple patterns. Protocone prominent; hypocone rudimentary to moderate; protoloph a continuous crest; anteroloph connected buccally with paracone, forming with protoloph a closed valley; posteroloph connected buccally with metacone, but metaloph reaching only to the well-defined metaconule; mesostyle rudimentary or absent. Lower fourth premolar and molars with protruding metaconid and marginal protoconid and hypoconid; mesoconid distinct, connected to protoconid and hypoconid by M-shaped ectolophid; hypoconid and entoconid connected only by posterolophid, the hypolophid represented at most by a minute spur from the entoconid; mesostylid small or absent.

DESCRIPTION

The type specimen, NMC 6479, is described here as a right P^4. Although the crests are not much worn, the individual cusps are poorly defined. The anterolph, protocone, hypocone, and posteroloph form a continuous U-shaped crest, to the ends of which the protoloph and metaloph unite buccally and with which the lingual end of the protoloph, but not the metaloph, is connected. The valley between anteroloph and protoloph is narrow and simple, but that between metaloph and posteroloph is partially divided into lingual and buccal portions by a low juncture of metaconule and posteroloph. The median valley is open buccally, with no trace of a mesostyle. Of the individual cusps, the protocone is the most prominent, being large and round. The metacone and metaconule are also distinct, but other cusps are represented only by slight swellings of the crest. The parastyle area projects anterad prominently. There is no external cingulum. Dimensions: anteroposterior, 2.20 mm; transverse, 2.44 mm.

A left P^4 (ROM 6276) is tentatively assigned to this species; although distinctly larger than the type, its structure is very similar. The projecting parastyle area gives the crown an obliquely ovoid shape. Wear has reduced the protocone and hypocone to elongate pits and excavated the paracone and metaconule; only the metacone remains unworn. The mesostyle is in the form of a small, linguad-projecting spur from the buccal margin. Dimensions: anteroposterior, 3.04 mm; transverse, 3.23 mm.

A right upper molar, presumably M^1(NMC 9132), is about the same size as the type P^4 but lacks the anterad-directed parastyle and is therefore more nearly quadrate in outline. The crests are lower than in the type, and the valleys are less deeply incised. The protocone is a prominent, bluntly pointed cusp, located in the middle of the lingual crest. The paracone is more prominent than the metacone. The mesostyle is represented by a minute cuspule with a single crest running linguad from it. The protoloph is poorly developed. The lingual wall of the crown bears two shallow vertical grooves, which partially define the hypocone and protostyle. Dimensions: anteroposterior, 1.87 mm; transverse, 2.29 mm.

A left upper molar, M^1 or M^2 (NMC 9170), is almost a mirror image of NMC 9132. The protocone is slightly less prominent, the metaloph slightly more oblique, the mesostyle slightly larger, and the metastyle with two prominences instead of one. Dimensions: anteroposterior, 1.96 mm; transverse, 2.49 mm.

Four upper molars in the ROM collection differ in various details from those described above. All are larger, corresponding more in size to the P^4, ROM 6276. ROM 6279 is a left M^1 or M^2, somewhat abraded. The protocone and paracone are prominent but the metacone is smaller. The lophs are poorly defined and the conules are small. There is only a vestigial hypocone and a minute mesostyle. The small parastyle is distinct from the paracone. Dimensions: anteroposterior, 2.67 mm; transverse, 3.50 mm.

Another left M^1 or M^2 (ROM 6280) is not only larger but relatively broader than NMC 9132. The paracone and metacone are subequal, and the lophs are well developed; the metaloph is cut off at the metaconule, with a low connection to the rudimentary hypocone. There is no parastyle, and the mesostyle is minute. Dimensions as preserved: anteroposterior, 2.90 mm; transverse, 3.20 mm.

A right upper molar, M^1 or M^2 (ROM 6281) is particularly broad anteroposteriorly. It also differs from NMC 9132 in having a more prominent hypocone. Resemblances are in the simple lophs and the reduced mesostyle. There is a minute protostyle at the anterolingual angle of the crown. Dimensions: anteroposterior, 2.65 mm; transverse, 3.17 mm.

A left upper molar, probably M^2 (ROM 6277), is not worn, but the cusps are low and rounded. The mesostyle is minute. The metacone is at the posterobuccal angle of the crown. The hypocone forms a distinct bulge at the posterolingual angle. There is a faint connection of metaconule to protocone. Dimensions: anteroposterior, 2.68 mm; transverse, 3.46 mm.

The only undoubted M^3 is a tooth from the right side (ROM 6282). Unfortunately it was badly worn in life. Only the paracone has not been planed off, and the area around the protocone is widely basined. The metacone

must have been low and situated on the broadly protruding posterobuccal shelf. Apparently there was no hypocone. Dimensions: anteroposterior, 2.52 mm; transverse, 2.93 mm.

Of the referred lower teeth, ROM 1822 is evidently a right P_4. In outline the crown tapers anterad. The protoconid and metaconid are close together but separated by a cleft. There is a small, spur-like mesoconid, but the mesostylid is represented only by a swelling on the cingulum behind the metaconid. The hypoconid, at the prosterobuccal angle, is prominent and knob-like. It is connected by the posterolophid to the small entoconid at the posterolingual angle. Dimensions: anteroposterior, 1.76 mm; transverse, 1.85 mm.

ROM 1823 is a left lower molar, probably M_2.The outline of the crown is rhombic, as in the M_2 of *Prosciurus relictus* (Cope) and *P. jeffersoni* (Douglass), but the structure is less complex. The protoconid, metaconid, and hypoconid are about as in *P. jeffersoni*, but the entoconid has no separate crest (hypolophid I). A low but distinct posterolophid connects the entoconid with the hypoconid. There is a distinct mesoconid but the mesostylid is obscure. Dimensions: anteroposterior (measured parallel to the lingual margin), 1.88 mm; transverse, 2.00 mm.

NMC 9133 is also a probable M_2. It is distinctly larger than ROM 1823 but similar in structure. The metaconid is the most prominent cusp and is connected to the protoconid by a crest that divides to enclose an oval valley just lingual to the protoconid. The posterolophid joining the hypoconid and entoconid is simple and marginal. The margins of the central valley are completed buccally by a distinct mesoconid and lingually by a small mesostylid. Dimensions: anteroposterior (measured parallel to the lingual margin), 3.22 mm; transverse, 2.81 mm.

The right M_3 (ROM 6278) is a small tooth, matching ROM 1823 but not NMC 9133. The anterior part of the tooth resembles that portion in ROM 1823, with a simple crest connecting the prominent metaconid and protoconid. The latter has a minute spur extending a short distance linguad from the apex. The large hypoconid is relatively more posterior than in ROM 1823, making the ectolophid with its mesoconid appear to be stretched out. From the bulging hypoconid the posterolophid curves anterolinguad, bearing a small entoconid and a rudimentary mesostylid in the lingual side. Dimensions: anteroposterior (measured parallel to the buccal margin), 2.40 mm; transverse, 2.05 mm.

REMARKS

Lambe (1908) described the type specimen of "*Sciurus*?" *saskatchewensis* as an upper left molar. In my earlier revision (Russell, 1934) I suggested that it was a left P^4; this was in error for right P^4. Wood (1937, p. 169) described it as a right upper molar but figured it as P^4. His illustration (fig. 17) fails to show the anterad-projecting parastyle that is evident in the stereoscopic photographs reproduced herewith (Fig. 5D). This feature is about as marked as in the P^4 of *Prosciurus vetustus* and is much more prominent than in any molars of that species.

There is considerable variation in size in the specimens described above

as *Prosciurus saskatchewensis*, even though they all fall within the structural definition of the species. There is a small-sized group, represented by the type and by NMC 9132 and 9170 and ROM 1822, 1823, and 6278. A large-sized group is made up of ROM 6276, 6279, 6281, 6282, and NMC 9133. Only a suite of specimens large enough for a statistical treatment will permit a decision as to the presence of one or two species. A third group, distinctly smaller than the typical *Prosciurus saskatchewensis*, is described below as a new species.

If the lower teeth assigned here to *P. saskatchewensis* truly represent that species, it is close to *P. jeffersoni* (Douglass) from Pipestone Springs, and distinct from the species represented by the lower jaw (AMNH 8750) from Cedar Creek that Wood (1937, p. 170) described as *Prosciurus* cf. *saskatchewensis*.

Prosciurus minor, sp. n.

Fig. 6H-K.

TYPE. ROM 6287, right M^2; Conglomerate Creek valley.

REFERRED SPECIMENS. ROM: 6380, left M^2; 6381, left M^3; locality V-38; 6288, left M^3, locality V-44.

SPECIFIC CHARACTERS

Upper molars similar in pattern to *P. saskatchewensis* but smaller; paracone the most prominent cusp; anteroloph terminates in a small parastyle that is well separated from paracone; metaconule simple, metaloph rudimentary; small but distinct mesostyle; hypocone on M^1 and M^2.

DESCRIPTION

The type specimen could be either M^1 or M^2; the latter seems more probable in the absence of any bulge of the anterior margin. All valleys between lophs are shallow. The anteroloph extends obliquely anterad from the protocone, then turns abruptly and continues straight buccad to the parastyle. There is a small but distinct protoconule on the protoloph. The rounded metaconule is connected to both protocone and metacone by the low metaloph. There is a small hypocone at the slight projection of the posteroloph at the postero-lingual angle of the crown. Dimensions: anteroposterior, 1.73 mm; transverse, 2.30 mm.

The left M^2 (ROM 6380) is an almost exact mirror image of the type specimen. The only noticeable difference is that the metaloph ends at the metaconule, leaving a gap between it and the protocone. Dimensions: anteroposterior, 1.81 mm; transverse, 2.23 mm.

Of the two left M^3, ROM 6288 is the less worn. The anteroloph is curved but does not close with the paracone. The protoloph is straight, with no distinct protoconule. The metacone is small. There is no true metaloph, but there are two minute conules on the line of the metaloph. The more lingual of these conules has an oblique connection with the posteroloph. The latter

extends from the protocone obliquely posterobuccad, with no trace of hypocone, then curves anterobuccad to the minute metacone. This arrangement leaves a flat, semicircular area of the crown bulging posterad. Dimensions: anteroposterior, 1.85 mm; transverse, 1.98 mm.

The second left M^3 (ROM 6381) shows what one would expect to see in ROM 6288 after moderate wear; only the protocone is distinctly levelled. The metaconule appears as a flattened spur from the posteroloph. The posteroloph has a metastyle, which is absent on ROM 6288. Dimensions: anteroposterior, 1.91 mm; transverse, 1.94 mm.

REMARKS

Specimens on which this species is based could be included in *P. saskatchewensis* on crown pattern alone. The only significant difference is that the hypocone, which is distinct in *P. saskatchewensis*, is rudimentary or absent in *P. minor*. It has been noted under *P. saskatchewensis* that specimens occur that are similar to the type of the species but are larger. To include the present material also with *P. saskatchewensis* would, I think, extend the size-range beyond that plausible for a single species. I prefer to distinguish the smaller teeth specifically, as they are less transitional to the typical *P. saskatchewensis* than are the large teeth. There is no doubt, however, that *P. minor* is closely related to *P. saskatchewensis* and may turn out to be only part of a single species with a very wide range in size.

Prosciurus vetustus Matthew, 1903

Fig. 6L; Fig. 7A.

REFERENCES

Sciurus (*Prosciurus*) *vetustus*, Matthew, 1903, p. 213, fig. 9; *Prosciurus vetustus*, Matthew, 1910, p. 63; Wood, 1937, p. 167, figs. 8, 10, pl. 23, fig. 4.

REFERRED SPECIMENS. ROM 1821, left P^4, locality V-40; ROM 6283, right M^1, locality V-37.

SPECIFIC CHARACTERS

Smaller than *P. saskatchewensis*. Upper dentition (P^4-M^3) with prominent protocone; protoconule distinct, although connected by protoloph to protocone and paracone; valley between protoloph and anteroloph open buccally; small but distinct mesostyle; metaconule double, the buccal conule connected to metacone by metaloph, but the lingual conule separate from protocone.

DESCRIPTION

The P^4 (ROM 1821), although well worn, clearly conforms to the definition of this species. The size is similar, and the anterad-projecting parastyle is well separated from the paracone. The metaloph clearly shows the remnant of a second metaconule buccal to the slightly larger, lingual metaconule. The M^1 (ROM 6283) is a much better preserved tooth, with only the pro-

tocone showing wear. The size matches that of the P^4 and is similar to that of the M^1 in the type of *P. vetustus*. The anteroloph is not divergent from the protoloph, as in the P^4, but the parastyle and paracone are completely separate. The metaconule appears at first glance to be a single, ovoid conule, but with oblique illumination the reflections from two separate apices are visible. There is a rudimentary hypocone but no distinct posteroloph. Dimensions; P^4, anteroposterior (parallel to buccal margin), 1.82 mm, transverse, 2.14 mm; M^1, anteroposterior, 1.82 mm, transverse, 2.22 mm.

Prosciurus major, sp. n.

Fig. 7B,C.

TYPE. ROM 6377, left M^1 or M^2; locality V-38.

REFERRED SPECIMEN. ROM 6284, right P^4; locality V-37.

SPECIFIC CHARACTERS

Size larger than that of any other known species of *Prosciurus*. Upper cheek teeth (P^4-M^3) with large, blunt cusps; protoloph nearly straight, without protoconule; anteroloph broadly curved, bringing rudimentary parastyle against paracone; metaconule rounded, almost as large as metacone; metaloph vestigial; distinct hypocone on molars; mesostyle distinct, ectoloph absent.

DESCRIPTION

The two specimens on which this species is based are not much worn. The low protoloph and the isolated metaconule give the whole crown a broadly basined appearance. The broad but enclosed valley between anteroloph and protoloph is distinctive. The hypocone on the molar is separated from the protocone by a distinct furrow on the lingual side of the crown. Dimensions: P^4, anteroposterior, 3.78 mm, transverse, 4.71 mm; M^1 or M^2, anteroposterior, 3.95 mm, transverse, 4.35 mm.

REMARKS

These teeth strongly resemble the upper teeth described by Wood (1937, p. 171, fig. 19) as *Prosciurus* sp., from the Brulé Formation. The Saskatchewan specimens are larger and lack the ectoloph. Otherwise it is difficult to separate the Brulé specimens from the present species.

Prosciurus major may be a species of *Pelecomys* Galbreath (1953), which differs from *Prosciurus* in larger size. However, the species of *Pelecomys* are based on lower dentitions, and the only upper tooth referred to the genus is an isolated M^1 or M^2 (University of Kansas 8344), which is smaller than ROM 6377 and has a protoconule. The relationships of *Prosciurus major* to *Pelecomys* can only be considered when associated upper and lower dentitions are found, either of *Prosciurus major* or of one of the species of *Pelecomys*.

Prosciurus altidens, sp. n.

Fig. 7D,E.

TYPE. ROM 6285, right P^4; Calf Creek valley.

REFERRED SPECIMENS. ROM 6378, left P^4; 6286, right M^1; locality V-38. A. E. Wood collection, 9052, left P^4.

SPECIFIC CHARACTERS

Size about as for *P. saskatchewensis* but cheek teeth high-crowned. P^4 and upper molars with deep central valley; anterior and posterior valleys not so deep, closed buccally by converging of anteroloph and posteroloph; protoloph connecting protocone and paracone, with protoconule small or absent; height of metaloph less between protoconule and metaconule than between metaconule and metacone; one or two connections between metaconule and posteroloph but no connection between metaconule and protoloph except through protocone.

DESCRIPTION

The high crown and the deep central valley of the upper cheek teeth are very conspicuous, even on worn specimens. The curious cross crests between metaconule and posteroloph are variable but distinctive. The specimen described by Wood (1937, p. 171, fig. 11) as *Prosciurus* aff. *lohiculus* Matthew and Granger appears from the illustration to be a left P^4, reversed. Wood, however, designated it as a right M^3. If this were so, the cross connections would be between protoconule and anteroloph, as Wood described them. The analogy between Wood's specimen and the P^4 of *P. lohiculus* is so close that I am sure of my identification. Compared with the type and other ROM specimens of *P. altidens*, Wood's specimen has a better developed protoconule, with a weaker link to the protocone. Dimensions: right P^4 (ROM 6285), anteroposterior, 2.00 mm, transverse, 2.41 mm; right M^1 (ROM 6286), anteroposterior, 1.86 mm, transverse, 1.83 mm.

REMARKS

As pointed out by Wood (1937), the resemblance of these teeth to those of *P. lohiculus* Matthew and Granger (1923) from the Hsanda Gol Formation (Oligocene) of Mongolia is great. The most significant difference is the presence in the Mongolian specimen of a crest joining metaconule to protoloph. Also the cross crests from metaconule to posteroloph are single in *P. lohiculus*. As suggested by Wood, *P. lohiculus* and *P. altidens* may represent a genus distinct from *Prosciurus*, but a decision on this must await the discovery of dental series of the latter species rather than isolated teeth.

Prosciurus spp.

Fig. 7F-I.

REFERRED SPECIMENS. ROM 1819, left M^1 or M^2; 1820, right M^1 or M^2; locality V-40. ROM 6290, left P^4; 6289, left M^3; Conglomerate Creek valley. ROM 6379, left M^3, locality V-38.

DESCRIPTION

In addition to the specimens described above, which are readily referable to species of *Prosciurus,* there are isolated teeth that are not so referable but which are inadequate to form the basis for new specific definitions. These are described herewith.

A left P^4 (ROM 6290) is too large to be included in *P. saskatchewensis* and too small for *P. major*, which it resembles in the distinct metaconule and the prominent parastyle. There is no mesostyle or hypocone. The size is that of the P^4 in the teeth described by Wood (1937, p. 171, fig. 18) as *Prosciurus* sp. from the Brulé of South Dakota. There is also some structural resemblance to the Brulé specimens, but the Cypress Hills tooth lacks a distinct external cingulum. Dimensions: anteroposterior, 2.75 mm; transverse, 2.15 mm.

The left upper molar (ROM 1819) is larger than the upper molars of *P. saskatchewensis* and also differs in the rudimentary mesostyle connected to the paracone, and in the presence of a buccal cingulum. As in *P. saskatchewensis*, the metaconule is simple. Dimensions: anteroposterior, 2.52 mm; transverse, 3.37 mm. The right upper molar (ROM 1820) is more worn but, except for the absence of the buccal cingulum, could represent the same species as ROM 1819. Dimensions: anteroposterior, 2.91 mm; transverse, 3.57 mm.

Of the M^3, ROM 6289 could have come from the same dentition as ROM 1819. The crown is subcircular in outline, produced posteriorly. The large protocone and paracone are joined by a slightly sinuous protoloph. The anteroloph is a curved ridge connected to paracone as well as to protocone; there is a faint cross-connection to the protoloph at the point where the protoconule would be. The metacone is on the buccal end of the curved posteroloph, more like a metastyle. From it a short metaloph extends anterolinguad to the metaconule, which has rudimentary connections to the protocone and to the posteroloph where the hypocone would be. There are two mesostyles filling the gap between paracone and metacone. Dimensions: anteroposterior, 3.18 mm; transverse, 3.02 mm. The other M^3 (ROM 6379) is slightly smaller but strongly resembles ROM 6289 in outline of crown, in the short, oblique metaloph, and the two mesostyles. Dimensions: anteroposterior, 2.88 mm; transverse, 2.71 mm.

Family Ischyromyidae
Genus *Ischyromys* Leidy, 1856
Type species: *Ischyromys typus* Leidy, 1856

GENERIC CHARACTERS

Molar teeth low-crowned, more or less quadrate, with four buccolingual crests and an anteroposterior crest. In the upper molars these crests are: protoloph joining protocone and paracone, metaloph joining hypocone and metacone, anteroloph (anterior cingulum) buccad from the protocone, posteroloph (posterior cingulum) buccad from the hypocone, lingual mure joining protocone and hypocone. In the lower molars the crests are: metalophid joining protoconid and metaconid, hypolophid joining hypoconid and

entoconid, anterolophid (anterior cingulum) linguad from the protoconid, posterolophid (posterior cingulum) linguad from the hypoconid, buccal ectolophid joining protoconid and hypoconid. There is no mesocone or mesoconid. The P_4 is molariform posteriorly, narrower anteriorly, with reduced crests. For characters of skull and postcranial skeleton see Wood (1937, p. 173). An abbreviated definition of the genus was given by Black (1968) and a discussion of molar variation by Howe (1966).

Ischyromys junctus, sp. n.

Fig. 7J; fig. 8A-D.

REFERENCES

Ischyromys typus, Lambe, 1908, p. 56, pl. 8, fig. 18; *Ischyromys typus nanus*, Russell, 1934, p. 56; *Ischyromys parvidens*, Wood, 1937, p. 192, fig. 24.

ETYMOLOGY

Latin *junctus*, "joined", in reference to the termination of anterolophid and metalophid.

TYPE. NMC 9169, right M_2, locality V-40.

REFERRED SPECIMENS. NMC 9131, right P_4, locality V-40; 6480, lower right molar, probably M_2, "4 miles above East End P.O." (Lambe, 1908); 9141, lower right molar, locality V-40. ROM: 6291, right P_4, locality V-38; 1824, 1826, lower molars, locality V-40; 6292, 6293, 6294, 6295, 6296, lower molars, localities V-38 and V-44.

SPECIFIC CHARACTERS

Lower molars small, intermediate in size between those of *I. typus* Leidy and *I. parvidens* Miller and Gidley; anterolophid and metalophid terminating against buccal side of metaconid, which connects them to a single crest to apex of metaconid; this arrangement encloses a triangular valley between anterolophid, metalophid, and metaconid; posterolophid forming a continuous curve around posterior margin of crown, almost reaching entoconid.

DESCRIPTION

Of the lower fourth premolars, NMC 9131 seems small in comparison with the other teeth of the species. It resembles the same tooth in *I. typus*, but the anterad taper of the crown is more accentuated and the valley between protoconid and hypoconid relatively wider. ROM 6291 is more nearly the correct size to go with the molar teeth. It is badly worn but shows the same curvature of the posterolophid as do the molars. The hypolophid, instead of being orientated transverse, is somewhat oblique, as the entoconid is slightly anterior to the hypoconid. Dimensions: ROM 6291, anteroposterior, 3.55 mm; transverse, 2.80 mm.

The 10 lower molars show various stages of wear, from unworn to nearly flat, but all display distinctive characters of the species. The outline of the

crown is rhombic, the metaconid angle being anterior to the protoconid angle. The metaconid is the largest and most prominent cusp. It has a curved crest extending marginally towards the entoconid and a short buccal crest that terminates abruptly at a steep declivity on the buccal side of the cusp. From the protoconid two crests, the anterolophid and the metalophid, diverge slightly to terminate at either end of the buccal side of the metaconid. The effect of this arrangement is to close completely the valley between anterolophid and metalophid. The entoconid is prominent, although not as high as the metaconid. There is a strong hypolophid, more or less concave anteriorly, which extends from the entoconid to a point on the ectolophid anterolingual to the hypoconid; in a few specimens the juncture is directly to the hypoconid. The posterolophid extends from the hypoconid in a sweeping curve around the posterior rim of the crown to the posterior slope of the entoconid, with which it unites after moderate wear. A slight thickening of the posterolophid near the hypoconid represents the hypoconulid. The ectolophid, joining protoconid and hypoconid, is strongly and obliquely curved, following the rim of the deep sulcus that penetrates the crown posterolinguad between the two buccal cusps. Dimensions: NMC 9169, right M_2 (type), anteroposterior, 3.12 mm, transverse, 2.97 mm; NMC 6480, right M_2 (Lambe's specimen), anteroposterior, 2.94 mm, transverse, 3.03 mm; ROM 6296, right M_3, anteroposterior, 3.40 mm, transverse, 3.00 mm.

REMARKS

The specimen (NMC 6480) described and figured by Lambe (1908) is slightly worn and does not show the distinctive features of the metaconid and associated crests as well as does the selected type and some other specimens. Lambe referred his specimen to *Ischyromys typus* Leidy. On the basis of the smaller size I referred it to *I. typus nanus* Troxell (Russell, 1934). Wood (1937) placed Troxell's subspecies under *I. parvidens* Miller and Gidley and included the Cypress Hills tooth under that species. The numerous molars now available in the Cypress Hills collections are consistently different from those of *I. parvidens* in the long, curved posterolophid. It should be noted that Wood's illustration of NMC 6480 (1937, fig. 24) shows the posterolophid shorter than it really is, as can be seen by comparing Wood's figure with the present stereoscopic photographs. The junction of the anterolophid and metalophid to the buccal side of the metaconid is almost unique. I have seen it elsewhere only in CM 8924, a left mandibular ramus from Pipestone Springs identified as *Titanotheriomys* sp. As this specimen also has the curved posterolophid, I regard it as close to, if not identical with, *Ischyromys junctus*.

The genus *Titanotheriomys* was erected by Matthew (1910, p. 63) to distinguish *Ischyromys veterior* Matthew (1903) from other species of *Ischyromys*. Black (1968) found that the skull characters used by Matthew to distinguish *Titanotheriomys* were also present in other species of *Ischyromys,* and he concluded that *Titanotheriomys* was a synonym. He also stated that the jaw and tooth distinctions that were supposed to separate *I. parvidens* Miller and Gidley (1920) from *I. veterior* break down completely. My own studies of specimens from Pipestone Springs in the Carnegie

Museum and from the Vieja Group, preserved in the University of Texas, have led me to an opposite conclusion, i.e., that *Titanotheriomys* is a valid genus, distinguished by elongate molars, in which the cingular crests, especially the posteroloph, are widely separated from the main crests.

Ischyromys sp.

Fig. 8E-G.

REFERRED SPECIMENS. ROM 6383, left upper molar; ROM 1835, 6298, right upper molars; all from Calf Creek valley, at or near locality V-38.

DESCRIPTION

The only upper molars of *Ischyromys* in the Cypress Hills collections are much too small to be associated with the lower teeth of *I. junctus*. ROM 6383 is almost unworn. The four cusps are about equal in size and rather conoid. Anteroloph and protoloph are nearly straight and parallel, so that the intervening valley is narrow. There is a slight curvature of the anteroloph towards the paracone at the buccal end. The hypoloph extends anterolinguad from the metacone to join the mure at a point anterobuccal to the hypocone. The mure is obliquely chevron-shaped, bordering the shallow sulcus that extends anterobuccad from the middle of the lingual margin almost to the centre of the crown. The posteroloph is slightly curved, giving a narrowly ovoid shape to the valley between it and the metaloph. The posteroloph is not connected to the metacone at this stage of wear. Dimensions: anteroposterior, 1.83 mm; transverse, 1.94 mm.

ROM 6298 is a right M^1 or M^2. The arrangement of cusps and crests is similar to that in ROM 6383, except that the anteroloph is joined to the protoloph about half-way between protocone and metacone, greatly restricting the valley between anteroloph and protoloph. Dimensions: anteroposterior, 1.73 mm; transverse, 1.74 mm.

The third specimen, ROM 1835, is smaller than either of the other two but resembles them in various features. However, the presence of a mesostyle makes the reference to *Ischyromys* questionable. Dimensions: anteroposterior, 1.24 mm; transverse, 1.34 mm.

Family Cylindrodontidae Miller and Gidley, 1918
Genus *Cylindrodon* Douglass, 1901
Type species: *Cylindrodon fontis* Douglass, 1901

GENERIC CHARACTERS

Cheek teeth high-crowned, with four transverse crests and a deep central basin. Upper molars oval in crown outline, without marginal re-entrant; central basin closed buccally by a narrow rim, with or without mesostyle. Lower teeth with central basin open broadly but shallowly on lingual side; marginal re-entrant between protoconid and hypoconid more or less oblique so as to open anterobuccad; hypoconid on M_1, M_2, and possibly M_3 projects more buccad than does the protoconid.

Cylindrodon collinus, sp. n.

Fig. 8H,I; Fig. 9A-E.

ETYMOLOGY

Latin *collinus*, "of a hill" (Cypress Hills) in analogy with *C. fontis*, "of a spring" (Pipestone Springs).

TYPE. NMC 9171, right mandibular fragment with incomplete I, relatively unworn P_4, M_2, and M_3, and broken M_1; Calf Creek valley, Fenley Hunter collection of 1936.

REFERRED SPECIMENS. NMC: 9137, presumed left P_4; 9372, presumed right P^4; 9138, left upper molar, presumably M^1; 5139, left upper molar, presumably M^2; 9134, left mandibular fragment with P_4-M_3; 9373, left P_4; 9135, right P_4; 6481, left mandibular fragment with M_1 (Lambe, 1908); 9172, 9374, 9375, left M_1 or M_2; 9371, left M_3. ROM: 1831, 6306, left M^1 or M^2; 1829, 6305, right M^1 or M^2; 6299, 6301, 6302, left P_4; 6300, 6307, 6384, right P_4; 1830, 6304, 6309, left M_1 or M_2; 6303, 6308, 6310, right M_1 or M_2. From various localities in Conglomerate Creek and Calf Creek valleys, except NMC 6481, which is from "4 miles above East End P.O." (Lambe, 1908).

SPECIFIC CHARACTERS

Lower molars with metalophid (protolophid of Burke, 1935; protolophulid II of Wood, 1937; metalophulid II of Wood and Wilson, 1936) usually transverse rather than anterolingually oblique. M_3 about as long as M_1 and M_2 but narrower and with the hypoconid not projecting buccad more than, or as much as, the protoconid. Molar crowns oval in outline at first, becoming quadrate with wear.

DESCRIPTION

The supposed right P^4 (NMC 9372) is almost unworn. The outline is ovoid-triangular, with the buccal margin curving obliquely into the anterior margin. The anteroloph is obliquely curved, but the protoloph is orientated directly transverse to the conspicuous paracone. The anterior basin is narrowly and obliquely ovoid, closed lingually. The central valley is moderately deep, with a shallow notch providing a partial lingual opening. The posterior basin is represented by three small, separate, ovoid pits, arranged in a curved line between hypocone and metacone. Dimensions: anteroposterior, 1.84 mm; transverse (at plane of wear), 1.68 mm.

The supposed left P^4 (NMC 9137) is moderately worn. It is broadly ovoid in outline, with the protoloph and metaloph diverging buccad. The anterior basin is almost obliterated; the remnant is in contact but not confluent with the buccal enamel wall. The central basin is deep lingually, becoming shallower and wider buccally but essentially closed by the buccal margin. The posterior basin is still conspicuous and has a slit-like notch on its buccal rim. Dimensions: anteroposterior, 1.70 mm; transverse, 1.60 mm.

The six upper molars in the combined collections are all worn. On NMC

9138 much of the crown pattern is still visible. It is ovoid in outline, with the posterior margin broadly truncated and the anterior margin narrowly truncated. The anterior basin is vestigial, not opening buccally. The central basin is large and deep, becoming shallow buccally, with a narrow notch on the buccal wall. The posterior basin is moderately large and closed buccally. A small mesostyle projects buccad from the rim of the central basin. Dimensions: anteroposterior, 1.92 mm; transverse, 1.54 mm.

Only one other upper molar, ROM 6305, needs to be described. On this tooth the protoloph has a small, bluntly pointed spur extending posterad into the central basin. The posterior basin is represented by a small buccal pit, and two vestiges in line lingually.

The only incisor that is definitely referable to this species is on the right mandibular fragment of NMC 9171, the type specimen. Unfortunately the functional part of the tooth has been broken away. It is not particularly massive and in cross-section is subcircular, flattened on the lingual side. It extends posterad within the horizontal ramus to a point slightly behind M_3. The P_4 of this specimen has a long, narrow trigonid, rounded anteriorly, and a wide, short talonid, with the hypoconid extending prominently buccad and anterad. The anterior basin is obliterated, but the central basin is still deep and reaches the lingual margin. The posterior basin is vestigial, isolated from the lingual margin. M_1 is broken, and more than the lingual half is missing. The hypoconid spur is similar to that of the P_4. On M_2 this spur is somewhat narrower and less prominent. Both anterior and posterior basins have been obliterated by wear. The central basin is still deep, the enamel walls do not coalesce at the lingual margin, and in consequence there is a slit-like opening. M_3 is about as long as M_2 but distinctly narrower, and the hypoconid spur is short and blunt and not extending as far buccad as the protoconid. The anterior basin is represented by a slight bump of enamel, the central basin is a subcircular pit, isolated from the lingual margin, and the posterior basin is vestigial. Dimensions: P_4, anteroposterior, 2.06 mm, transverse (at plane of wear), 2.01 mm; M_1, anteroposterior, 1.72 mm; M_2, anteroposterior, 1.82 mm, transverse, 1.91 mm; M_3, anteroposterior, 1.70 mm, transverse, 1.50 mm.

With isolated lower molars there is no sure way of distinguishing between M_1 and M_2. ROM 6303, presumably M_1, is quite unworn and probably was never erupted. The enamel margin of the crown is high and forms an ovoid rim, outside of which is the unworn hypoconid spur. Metalophid and hypolophid are low, and they form the walls of the deep, circuloid central basin. The entoconid is a prominent, marginal cusp, the metaconid slightly less prominent, and there is a narrow notch between the two cusps that forms a lingual opening to the central basin. In the angle between metaconid and anterolophid there is a minute circular pit, with raised walls. Dimensions: anteroposterior, 2.11 mm; transverse, 1.90 mm.

With progressive wear of the lower molars, the grinding area soon extends onto the hypoconid spur. The entoconid is worn down to the grinding plane, and the anterior and posterior basins become restricted. Next the anterior basin disappears, then the posterior, and finally the central basin, leaving only a broad scar on the grinding surface. The marginal enamel wall

remains intact, and presumably functional at this stage, although it is very low on the anterior margin.

The mandibular bone, as seen in NMC 9171 and 9134, is relatively massive and is deeper at the front of the cheek-tooth row than at the rear. Posteriorly the ventral margin of the bone flares downward as part of the rim of the masseteric fossa, which extends as far forward as the rear of M_2. The mental foramen, situated about half-way between the alveolus of the incisor and the front of the P_4, is nearer to the dorsal than to the ventral surface of the mandible.

REMARKS

Judging from the number of specimens available, *Cylindrodon fontis* was the commonest rodent in the Cypress Hills fauna. The cheek teeth are readily recognized by the four transverse crests, and the lower molars by the deep, oblique re-entrant between protoconid and hypoconid.

The Cypress Hills cylindrodonts have been referred to *C. fontis* Douglass, with or without reservations, and in fact the specimen originally reported by Lambe (NMC 6481) resembles the lower molars of that species closely, as noted by Wood (1937, p. 202). But the remaining lower teeth from Saskatchewan more closely resemble those described by Wood (1937, p. 203) as *Cylindrodon*, sp. nov., from the Lower Oligocene of Beaver Divide, Wyoming. Features in common are the transverse metalophid (protolophulid II of Wood) and the narrow talonid on M_3. The outline of the lower molars is more nearly quadrate in the Cypress Hills specimens than in *C. fontis* or the Beaver Divide teeth, and in this respect the resemblance is to the type of *C. nebraskensis* Hough and Alf (1956) from the Chadronian of Nebraska. But the crown outline is strongly altered by wear and therefore is of dubious taxonomic value.

In my opinion there is less chance of confusion for future workers if the Cypress Hills material is recognized as distinct specifically, rather than referred to any previously described species. If Wood (1937) had formally designated the Beaver Divide species, it would probably have been necessary to include in it the Cypress Hills specimens. So until further comparisons can be made, I tentatively include the Beaver Divide specimens in *C. collinus*.

Family Eutypomyidae Miller and Gidley, 1918
Genus *Eutypomys* Matthew, 1905
Type species: *Eutypomys thomsoni* Matthew, 1905

GENERIC CHARACTERS

Small to medium-sized castoroid rodents, with moderately high-crowned cheek teeth, the basic pattern of which consists of four or five transverse crests that are complicated by numerous spurs, cross-connections, and subsidiary crests. With moderate wear this complex of crests is reduced to a large number of irregularly disposed lakes. In the upper molars the marginal re-entrant between protocone and hypocone opens posterolinguad. In the lower molars the marginal re-entrant between protoconid and hypoconid opens anterobuccad.

Eutypomys parvus Lambe, 1908

Fig. 9F-K

REFERENCES

Lambe, 1908, p. 57, pl. 6, figs. 1, 2; Wood, 1937, p. 232, fig. 43.

TYPE. NMC 6482, a right P_4, from "4 miles above East End P.O." L. M. Lambe, 1904.

REFERRED SPECIMENS. NMC 9197, left M^1 or M^2. ROM: 6311, 6314, right M^1 or M^2; 6312, left M_1; 6313, right M_2. From various localities in Conglomerate Creek and Calf Creek valleys.

SPECIFIC CHARACTERS

Size relatively small. Upper molars with protolophules I and II and more or less distinct metalophule I. Lower molars with protoconid and its crest separated from the metalophid by a deep, narrow cleft.

DESCRIPTION

The type specimen was described by Lambe (1908) as a left M_3, but Wood (1937) pointed out that it is undoubtedly a right P_4. Allowing for the misorientation, Lambe's description is excellent and need not be duplicated here.

Of the three upper molars, ROM 6311 is almost unworn, a rare condition with teeth of this genus. The crown is wider at the protocone than at the hypocone, which by comparison with *E. thomsoni* suggests that it is M^2. The protocone forms a shallow, W-shaped crest on the anterolingual margin of the crown, from which three transverse crests extend buccad. The middle crest, protolophule I, is the most distinct and extends directly to the prominent paracone. From the anterior arm of the protocone the anteroloph extends parallel to the protolophule I but does not join the paracone; however, it has a cross-crest to the protolophule I near the protocone. The third crest, protolophule II, originates from the posterior arm of the protocone. It is somewhat irregular and has a cross-connection with the protolophule I just buccal to the cross-connection between protolophule I and the anteroloph. Beyond this cross-connection the protolophule II is slightly interrupted, then bifurcates, the anterior branch uniting with the paracone, the posterior branch terminating like a mesostyle. In addition to the cross-connections, protolophule I has several short spurs. The hypocone is similar to the protocone in form but is not so prominent. The metalophule II extends from the centre of the hypocone straight to the prominent metacone. The posteroloph originates from the posterior arm of the hypocone, is parallel to and well separated from the metalophule II, with a cross-connection near the hypocone. The metalophule I, from the anterior arm of the hypocone, extends buccad parallel to the protolophule II, with a cross-connection that forms in the inner end of the marginal re-entrant. There are two cross-connections between metalophule I and metalophule II, the more lingual oblique, the other transverse. The metalophule I terminates at the buccal

margin as if it were a second mesostyle; it is not connected to the metacone, although that cusp has a short spur towards it. All valleys and clefts between the various crests are deep. Dimensions: anteroposterior, 2.14 mm; transverse (base of crown), 2.56 mm.

The left upper molar (NMC 9197) is partly worn, although not enough to obscure the pattern of crests. The two lingual cusps form oblique crests rather than anteroposterior W's. Anterobuccally the protocone crest continues as the anteroloph, which is simple, reaching but not uniting with the paracone. The protolophule I extends obtusely from the protocone crest, then buccad to the paracone, which is small. This crest has a hook-shaped spur extending posterad, then linguad. The protolophule II extends buccad from what must have been the apex of the protocone. At the buccal margin it curves anterad to touch the paracone; there is a small spur pointing towards the hook on the protolophule I. The oblique crest of the hypocone extends anterolinguad to join the protolophule II near its origin. About halfway between this juncture and the lingual tip of the hypocone, the metaloph projects at about right angles. It then trifurcates, the middle branch or metalophule II extending with a slight curve to the large metacone. The anterior branch, metalophule I, curves anterobuccad, then buccad, to terminate against the metacone distinctly internal to the buccal margin. The posterior branch extends posterad to the posteroloph and in this stage of wear encloses two small lakes. The posteroloph forms the posterior margin of the crown, from tip of hypocone to the metacone, from which it is separated by an oblique cleft. The tooth has one large lingual root and two small buccal roots. Dimensions: anteroposterior, 2.78 mm; transverse (at plane of wear), 2.80 mm, or (at base of crown), 3.30 mm.

The other right upper molar (ROM 6314) shows the stage of wear that would have eventually been reached by ROM 6311. Although the paracone and metacone are still distinct, the protocone and hypocone have been reduced to irregular basins. The protolophule I is still recognizable and has a cross-connection to the anteroloph. This cross-connection forms a narrow lake with the anteroloph and a cleft between crest and paracone. The central area of the crown is occupied by five lakes of various configurations. One lake is excavated in the distinct mesostyle. The metalophule II has an 8-shaped lake both anteriorly and posteriorly. The posteroloph is divided by a tiny lake adjacent to the metacone. The lingual re-entrant extends anterobuccad into the crown but opens more linguad than posterad. Dimensions: anteroposterior, 2.45 mm; transverse, 2.65 mm.

The presumed left M_1 (ROM 6312) has the trigonid narrower than the talonid, whereas in the presumed right M_2 (ROM 6313) these two parts are about equal in width. Otherwise the two teeth are similar. The protoconid and hypoconid are separated by a deep marginal re-entrant, which opens more buccad than anterad. From the protoconid a crest curves anterolinguad; it has several short spurs extending posterad, one of which joins or touches the mesolophid. This protoconid crest is separated by a deep, narrow cleft from the metalophid. The latter crest is joined to the anterolophid buccally, the two forming an oval valley that is divided by a bifurcated cross-crest, single on the metalophid side, double on the anterolophid side.

The metaconid is the largest cusp of the tooth. The mesolophid originates at the anterior tip of the hypoconid but has united with that cusp at this stage of wear. This loph almost immediately bifurcates, the anterior arm extending almost straight linguad. On the M_1 it terminates discretely at the lingual margin, but on the M_2 it curves to abut against the entoconid. A posterior branch of the mesolophid runs parallel to the anterior branch for a short distance, then terminates against a spur from the hypolophid without joining with it. The hypolophid extends transversely from the hypoconid crest and has short spurs on the anterior side. The posterolophid is curved, forming the posterior margin of the crown. It is united with both hypoconid and entoconid. On the M_1 it has two spurs on the anterior side, one of which encloses a minute lake. On the M_2 the posterolophid is without spurs. Dimensions: ROM 6312, anteroposterior, 2.75 mm, transverse, 2.53 mm; ROM 6313, anteroposterior, 3.11 mm, transverse, 2.60 mm.

REMARKS

The assignment of the five molar teeth described above to *Eutypomys parvus* is of course tentative until lower molars are found associated with P_4 and the upper molars with the lower dentition. However, since all of these teeth, including the type specimen, are distinctly smaller than those of other described species, the presumption seems reasonable. In addition to smaller size, the Cypress Hills molars seem to have a more complex crown pattern than those of *E. thomsoni*, but that may be because the former are relatively little worn.

Eutypomys, cf. *magnus* Wood, 1937

Fig. 10A,B.

REFERRED SPECIMENS ROM 6315, right P^4; 6316, left M_1 or M_2; Conglomerate Creek valley.

DESCRIPTION

On the right P_4 the anterior enamel wall of the crown has been broken away, so that little remains of the protoconid and metaconid. The central area of the trigonid contains two lakes; the larger, almost circular, is near the buccal margin, the smaller, ovoid one, posterolingual to the larger. Much of the talonid area is occupied by an L-shaped lake. The talonid is much wider than the trigonid. The hypoconid projects anterobuccad, with a narrow, oblique, marginal re-entrant separating it from the trigonid. Dimensions: anteroposterior, as preserved, 5.17 mm; transverse (talonid), 4.31 mm.

The left molar is damaged in the metaconid portion, and the anterior part of the crown between protoconid and metaconid is difficult to interpret. The anterolophid appears to have a posterior projection, forming an incipient lake. This crest does not seem to have reached the metaconid. There is a vestige of a buccal spur from the metaconid. The crest that was called mesolophid by Wood (1937) is almost straight and transverse; it extends from the posterior arm of the protoconid almost to the lingual wall. Its base is joined to that of the hypolophid by a simple ectolophid, the continuation

of the posterior arm of the protoconid. The hypolophid is orientated linguad and slightly posterad and is essentially straight, but there is one crenulation on the anterior wall and several on the posterior. The posterolophid is broadly curved and appears to be slightly interrupted before it reaches the entoconid. On the buccal margin of the crown the protoconid and hypoconid project about equally. The marginal re-entrant between these two cusps is wide; the wall formed by the protoconid is oblique, that formed by the hypoconid is transverse to the long axis of the crown. Dimensions: antero-posterior, as preserved, 4.75 mm; transverse, 4.03 mm.

REMARKS

These teeth are in the size range of *Eutypomys magnus* as described by Wood (1937, p. 233, fig. 45). As far as the worn condition of the Cypress Hills specimens permits comparison, there are also structural resemblances, such as the presence of an ectolophid, and a simple mesolophid arising from it. *E. magnus* is from the lower part of the Brulé Formation of South Dakota and is therefore somewhat younger than the Cypress Hills specimens.

Family Eomyidae Deperet and Douxami, 1902
Genus *Adjidaumo* Hay, 1899
Type species: *Gymnotychus minutus* Cope, 1873

GENERIC CHARACTERS

Small eomyids with brachyodont teeth having four rather distinct cusps. Molar pattern consisting basically of five transverse lophs. Upper molars with anteroloph joined to protoloph rather than to protocone and extending anterad, then turning laterad to form part of anterior margin; mesial part of anterior margin formed by cingulum-like extension from angle on anteroloph. Posteroloph with similar relationships to metaloph. Mesoloph short. Lower molars with similar relationships of metalophid and anterolophid, and of hypolophid and posterolophid. Mesolophid short. P_4 with molariform talonid; anterior part narrow, with two simple cusps.

***Adjidaumo stewarti*, sp. n.**
Fig. 10C,D

ETYMOLOGY

Named in honour of the late Mr. R. T. Stewart, former owner of the ranch on which most of the fossil localities occur and a hospitable host to many palaeontological expeditions.

TYPE. ROM 6317, left maxillary fragment with M^1 and M^2; Calf Creek valley.

REFERRED SPECIMENS. ROM 1836, right M^1 or M^2; ROM 6318, left maxillary fragment with M^2; Conglomerate Creek valley.

SPECIFIC CHARACTERS

Cheek teeth larger than those of other known species. Linguad extension of cingulum from anteroloph and posteroloph distinct but not as high as the lophs; anterior cingulum bulging slightly anterad. Mesostyle distinct, situ-

ated on ectoloph joining paracone and metacone. Mesoloph distinct but not reaching mesostyle.

DESCRIPTION

The two molars of the type specimen are almost identical, M^1 being slightly worn, M^2 almost unworn. The distinct bulge of the anterior cingulum at the anterolingual corner forms a basined shelf that on M^2 overlaps the posterior cingulum and on M^1 abuts against the hypocone. The protocone, paracone, and hypocone are prominent and about equally developed; the metacone is somewhat less prominent. All crests are sharp and simple, including the reduced mesoloph, and the valleys between are relatively broad. There is no distinct mesocone, its position being marked by the junction of mesoloph and mure at about the centre of the crown. The mure of the M^1 is short and is orientated anteroposteriorly; that of the M^2 is slightly oblique and longer. Dimensions: M^1, anteroposterior, 1.86 mm, transverse, 2.07 mm; M^2, anteroposterior, 2.00 mm, transverse, 2.08 mm.

The right upper molar (ROM 1836) is probably M^1. It is more worn than that tooth in ROM 6317 but still shows the characteristic features. The mesostyle and mesoloph are not quite so well developed. The M^2 of ROM 6318 is imperfect on the buccal side. Protocone and hypocone have been reduced to broad, shallow basins and the valley between to a narrow slit, but there is still a distinct remnant of the mesoloph.

REMARKS

Size, the most distinctive feature of this species, is more within the range of species of *Paradjidaumo*, but the distinctive relationships of the cingulum to the anteroloph make reference to *Adjidaumo* mandatory. The absence of lower teeth referable to this species makes structural comparisons with other species of *Adjidaumo* difficult, but as Wood pointed out (1937), upper and lower molars are almost mirror images of each other.

Adjidaumo hansonorum, sp. n.

Fig. 10E-I.

ETYMOLOGY

Named in honour of Messrs E. B. and V. F. Hanson, the present owners of the ranch on which most of the fossil localities occur and who have carried on the tradition of friendly co-operation with the palaeontologists.

TYPE. ROM 1827, an unworn right M_1 or M_2, from Conglomerate Creek valley.

REFERRED SPECIMENS. ROM: 6139, 6385, right M^1 or M^2; 6323, right DP_4; 1834, left P_4; 1833, 6321, right P_4; 6322, 6386, left M_1 or M_2; 6320, left M_3; from various localities in the valleys of Conglomerate and Calf Creeks.

SPECIFIC CHARACTERS

Cheek teeth slightly larger than those of *A. minimus*. Lower molars similar to those of *A. douglassi* but with internal part of hypolophid transverse

rather than oblique; posterolophid reaching entoconid. Referred upper molars with anteroloph connected to protoloph by a short commissure, but cingulum-continuation of anteroloph represented only by a minute vestige.

DESCRIPTION

On the assumption that all of the listed specimens belong to a single species, I shall begin the description with the two upper molars. Of these, ROM 6385 is the less worn. It is shorter and broader than the lower molars. The protoloph runs obliquely anterobuccad from the protocone, then turns directly buccad to the paracone. At the angle the anteroloph projects anterad, then turns at right angles to parallel the protoloph and join the base of the paracone at the anterolingual angle of the crown. The crests associated with the hypocone are similar to those of the protocone, except that the metaloph is a little oblique. The mesoloph is distinct but terminates about half-way to the buccal margin. There is a rudimentary mesostyle. The posteroloph extends from the hypocone to the metacone; it is straight for most of its length but curves slightly to meet the metacone. Unlike its analog, the posterolophid of the lower molars, the anteroloph does not have a cingulum spur, this being represented only by a slight posterolingual indentation of the crown. The deep valley between protocone and hypocone does not produce a marginal re-entrant to the crown. Dimensions: anteroposterior, 1.34 mm; transverse, 1.61 mm.

Of the referred P_4, ROM 6321 is the least worn. The trigonid is narrower than the talonid and has the rounded protoconid and metaconid joined by a short crest; there is no anterolophid or cingulum. The ectolophid near the buccal margin joins the protoconid and hypoconid and gives rise to a mesolophid that just reaches the lingual margin. The talonid is similar to that of the molars, but the lingual part of the posteroloph is slightly oblique. Dimensions: anteroposterior, 1.63 mm; transverse, 1.38 mm.

The type specimen, ROM 1827, is a quite unworn right lower molar. The trigonid is higher and narrower than the talonid, suggesting that the tooth is M_1. The anterolophid forms the anterior margin of the crown, without a separate part that can be recognized as a cingulum. The commissure to the metalophid is rudimentary. The hypolophid is directed buccad, as in *Paradjidaumo*, not anterobuccad as is usual in *Adjidaumo*. The mesolophid is distinct but does not reach the lingual margin; its simple termination is closer to the metaconid than to the entoconid. The buccal part of the hypolophid and the posterolophid form a continuous crest, which runs posterolinguad from the hypoconid, then curves anterobuccad to meet the base of the entoconid. At the point where the curve begins, the lingual part of the hypolophid projects at right angles, then turns directly linguad to join the entoconid. Dimensions: anteroposterior, 1.37 mm; transverse, 1.35 mm.

The left M_3 (ROM 6320) is similar in the structure of the trigonid to the more anterior molars. This specimen has a well-developed commissure between anterolophid and metalophid at about the midlength of the crown. The talonid, in contrast to that of M_1 and M_2, is narrow and produced, as if the cusps and crests had been pulled posterad. The mesolophid is directed posterolinguad, and the ectolophid is relatively long, with a slight angulation.

The hypolophid projects directly from the hypoconid; after joining with the ectolophid it extends linguad to meet the entoconid. The posterolophid is more strongly curved than in M_1 and M_2 and is united with the hypolophid in the entoconid. Dimensions: anteroposterior, 1.48 mm; transverse (at the trigonid), 1.17 mm.

The right DP_4 (ROM 6323) is only tentatively referable to the present species. It is larger than the lower molars described above but seems to be too small to be associated with *A. stewarti*. The outline of the crown is asymmetrically ovoid, almost pointed in front and nearly straight behind. Most of the cusps are worn. Using molar terminology, the protoconid is more posterior than the metaconid and is obliquely Y-shaped. One arm is directed anterad and the other linguad, and both terminate free. The metaconid is ovoid and gives off a curved crest, concave lingually, to the anterior end of the crown, where it merges with the paraconid-like prominence. From that point the crest extends posterobuccad along the rim of the crown but ends well in front of the protoconid, leaving an open valley. The talonid is more molariform. The hypoconid is well worn; it gives off a hypolophid lingually to join with the entoconid. It also gives rise to a posterolophid, which extends linguad and a little posterad, then curves gently along the posterolingual rim but does not reach the entoconid, leaving a narrow, open valley formed with the hypolophid. There is no true mesolophid, but a small, obliquely triangular cusp is situated at about the centre of the crown in a large transverse valley; it has a rudimentary connection with the hypolophid. On the sides of the crown there is a rounded re-entrant between metaconid and entoconid and a vestige of a re-entrant between protoconid and hypoconid. Dimensions: anteroposterior, 2.31 mm; transverse, 1.55 mm.

REMARKS

The lower cheek teeth of this species are approximately the same size as those of *Adjidaumo minutus* (Cope) from the Middle Oligocene but are structurally closer to those of the smaller *A. douglassi* Burke from the Upper Oligocene of North Dakota. The most obvious difference from *A. douglassi* is the transverse, rather than oblique, orientation of the hypolophid. Another distinctive feature is the long posterolophid, which normally joins the entoconid. This character, as well as the larger size, also distinguishes *A. hansonorum* from *A. minimus* (Matthew) of the Pipestone Springs fauna.

Family Cricetidae de Rochebrune, 1883
Genus *Eumys* Leidy, 1856
Type species: *Eumys elegans* Leidy, 1856

GENERIC CHARACTERS

Cricetid rodents with brachyodont cheek teeth. Molar pattern based on five transverse crests that tend to be orientated obliquely rather than transversely. Protocone more closely associated with anteroloph than with protoloph. Posterior arm of protoconid extending obliquely towards lingual margin. Mesocone and mesoconid usually present. M^1 with prominent anterocone.

Eumys pristinus, sp. n.

Fig. 10J, K; Fig. 11A-D.

ETYMOLOGY

Latin *pristinus,* in the sense of "early".

TYPE. ROM 6324, unworn right M^1, from Conglomerate Creek valley.

REFERRED SPECIMENS. ROM 6325, left M^2; 6326, left M^3; 6327, right M_2; 6328, 6329, left M_2; 6330, right M_3. From Calf Creek and Conglomerate Creek valleys.

SPECIFIC CHARACTERS

M^1 with prominent anterocone, having several posterior spurs. Mesoloph usually long. Posterior arm of protoconid long, oblique, terminating closer to metaconid than to entoconid. Buccal part of anterolophid shorter than lingual part.

DESCRIPTION

The type specimen, a well-preserved right M^1, has a very prominent anterocone that projects anterad like an arrowhead, formed by the cusp and the two halves of the anteroloph. From the posterior side of the anterocone/anteroloph complex project three rudimentary spurs, one towards the protocone, one towards the anterior arm of the protocone, and one towards the paracone. The anterior arm of the protocone is interrupted before it joins the middle spur of the anterocone. The posterior arm (protoloph) curves posterobuccad and continues as the mure, but the protoloph proper diverges anterobuccad to join the prominent, rounded paracone. The mesoloph rises from the midlength of the mure at a poorly defined mesocone; it is transverse and reaches slightly more than half-way to the buccal margin. The hypocone is continuous with the mure anterobuccally and sends off a short metaloph posterobuccad to the rounded metacone. Posteriorly the hypocone curves into the posteroloph, which forms the posterior margin of the crown and curves to join the metacone. The valley between protocone and hypocone is transverse in its lingual part but curves anterad near the middle of the tooth. Dimensions: anteroposterior, 2.72 mm; transverse, 1.85 mm.

The left M^2 (ROM 6325) is well worn but shows the characteristic obliquity of the crests. The protocone is represented by a large basin, which merges into the anteroloph; the latter curves to join the paracone. The protoloph projects at right angles from this basin and joins the mure and the paracone. The mure continues obliquely posterolinguad into the hypocone basin, giving off a short mesoloph at about midlength. The metaloph is much longer than the protoloph, and the posteroloph curves to barely reach the base of the metacone. Dimensions: anteroposterior, 1.96 mm; transverse, 1.93 mm.

The left M^3 (ROM 6326) is badly worn but has a relatively high crown. The anterior portion is a transverse basin representing the protocone, paracone, anteroloph, and protoloph. The mure is short and broad and joins with an irregular basin representing the mesoloph, metaloph, and metacone. The

relatively small hypocone is joined to this basin by a short, oblique loph. Marginal notch between protocone and hypocone is short and bifurcated. The posterior margin of the crown is excavated as if the posteroloph had failed to develop, but there is a small spur directed posterolinguad from the metacone. Dimensions: anteroposterior, 2.32 mm; transverse, 2.00 mm.

The right M_2 (ROM 6327) is complete but well worn. It is almost as wide as long. The protoconid is part of a broad basin that joins the metaconid by the combined metalophid/anterolophid. The posterior arm of the protoconid is moderately oblique and almost reaches the lingual margin of the crown close to the posterior corner of the metaconid. The anteroloph is short and longitudinal and gives off a short mesolophid and a long, loph-like mesoconid. The hypoconid appears as an oval basin, to which the ectolophid and hypolophid are connected at the anterolingual corner and from which a posterolophid forms the posterior margin of the crown, just reaching the posterior base of the rounded entoconid. Dimensions: anteroposterior, 2.34 mm; transverse, 2.01 mm.

The two left second lower molars are relatively unworn but unfortunately are incomplete. The better preserved of the two (ROM 6328) lacks the anterolingual corner of the crown. Allowing for difference in wear, it closely resembles the right M_2 described above. However, it shows that at this stage of wear there is a short anterior arm of the protoconid that joins the anterolophid and from which also presumably the metalophid originated from the metaconid. The buccal branch of the anterolophid is evidently shorter than the missing lingual branch. The posterior arm of the protoconid is oblique and terminates at the posterior base of the metaconid. The ectolophid is slightly chevron-shaped and has a small mesoconid and a very short mesolophid. The hypolophid extends anterolinguad to join the ectolophid, then turns linguad to the entoconid. Also from the hypoconid a posterolophid extends posterolinguad to the crown margin behind the entoconid. The marginal notch between protoconid and hypoconid is short and bifurcate. The other left M_2 (ROM 6329) lacks most of the talonid. The anterolophid and the posterior arm of the protoconid are similar to those of ROM 6328, but the mesoconid is closer to the protoconid. Dimensions: anteroposterior, 2.23 mm; transverse, 2.06 mm.

The right M_3 (ROM 6330) is well worn and in outline tapers from front to rear. The protoconid/metaconid area is similar to that of ROM 6327, as is the posterior arm of the protoconid. There is a small mesoconid but no mesolophid. The hypoconid/posterorlophid area is reduced to a broad, oblique crescent from which the transverse hypolophid and the longitudinal ectolophid emerge jointly. Dimensions: anteroposterior, 2.22 mm; transverse, 2.00 mm.

REMARKS

The genus *Eumys* is known from Lower Oligocene beds only in the "*Chadronia* Pocket" near Crawford, Nebraska (Wood, 1969). It has not been reported from the rich Pipestone Springs beds, the fauna of which resembles that of the Cypress Hills Formation in many other respects.

Four species of *Eumys* have been described from the Middle and Upper

Oligocene: *E. elegans* Leidy, *E. parvidens* Wood, *E. brachyodus* Wood, and *E. obliquidens* Wood. Part of the distinction is in the size of the cheek teeth. In *E. pristinus* the average size of the molars appears to be between that of *E. elegans* and *E. brachyodus*. From the former species *E. pristinus* differs in the shorter crown of M_2, the unequal division of the anterolophid, and the approximation of the posterior arm of the protoconid to the metaconid. Differences from *E. brachyodus* are not as obvious; the crown of M_2 is smaller and a little more nearly rectangular, and there is a mesolophid in some specimens. When the M_1 of *E. brachyodus* is known it will probably differ from that of *E. pristinus* in the anterocone.

Order Carnivora Bowdich, 1821
Suborder Creodonta Cope, 1875

REMARKS

The Creodonta, as the group was defined by Cope (1875, 1884) and revised by Matthew (1909, 1915), has been whittled away by other authors until its taxonomic validity is seriously questioned. First to be removed were the Miacidae (Eurcreodi of Matthew), which Wortman (1901) transferred to the Fissipeda. The Arctocyonidae (Procreodi of Matthew) were shown by Russell (1954) to have affinities with the condylarths and were placed in the Condylarthra by Patterson (in Patterson and McGrew, 1962) and Van Valen (1966). Van Valen also removed the Mesonychidae (Acreodi of Matthew) to the Condylarthra, on the grounds of their supposed derivation from the arctocyonids. The final blow was administered by Van Valen (*op. cit.*), who included the remainder, the Oxyaenidae and the Hyaenodontidae (Pseudocreodi of Matthew), in his new order, the Deltatheridia.

I concur with only the first two of the above-noted revisions. The Miacidae are so very clearly antecedent to the Canidae that their inclusion in the Fissipeda is well justified. The Arctocyonidae, whether they are condylarths or not, obviously do not belong in the Carnivora. However, the retention of the other three families in a more or less natural group, the Creodonta, still has supporting evidence, as will be discussed in more detail in a forthcoming paper. Meanwhile, however, it is necessary to give a résumé of this evidence here to justify retention of the Creodonta as a valid taxon.

The point that I tried to make in my paper of 1954, and which seems to have been missed, is that there are two trends in the development of the mammalian molar pattern in Paleocene and Eocene times, beginning, as we now know, in the Late Cretaceous. These might be called protungulate and protocarnivore. The former is characterized by an early reduction of the paraconid, so that it becomes either a cuspule on the anterior side of the metaconid or disappears entirely, leaving only the non-cuspate termination of the protolophid, sometimes called the parastylid. This degeneration of the paraconid begins even before the characteristic trend in the upper molars, in which the lingual margin becomes broad anteroposteriorly, and a hypocone appears at the posterolingual angle, either by a local enlargement of the

cingulum or by budding from the posterior side of the protocone. Both of these changes in molar pattern, loss of the paraconid and addition of the hypocone, lead from the pure tribosphenic to the quadritubercular molar. They occur not only in the ancestors of the ungulates but also in those of the primates, proboscideans, and some insectivores.

The protocarnivore trend is in direct contrast. The paraconid remains about equal in size to the metaconid (which later degenerates) and develops an anterad orientation, forecasting the paraconid blade of the sectorial lower molar. In the upper molars the hypocone does not appear until late in carnivore evolution. Even the protocone is of secondary importance, and the emphasis is on the paracone and metacone, which are more or less connected by an ectoloph and extended by elongation of the parastyle or metastyle. These changes represent the beginning of sectorial adaptation in the upper molars.

The protungulate molar was well developed by Late Cretaceous times. The protocarnivore molar is not certainly known earlier than Early Paleocene, but it is so close to the generalized tribosphenic molar that it must have been present in Late Cretaceous time. A possible record of such an occurrence was noted elsewhere (Russell, 1962). It is clear that a group of mammals launched on the protungulate course of molar development could not transfer to the protocarnivore course without an improbable reversal of evolution. The converse is not so certain and in fact the ursids did make the change, but that was a much later event.

Applying these general observations to the groups that have been classed as creodonts, one can see why the arctocyonids, with their reduced paraconid and incipient hypocone, are not carnivores and may be included in the Condylarthra. The status of the mesonychids is more obscure because of the curiously modified molar pattern. However, the hypocone is always absent, and the paracone and metacone are aligned along the buccal margin, with or without a parastyle, in the same manner as in the accepted carnivores of the early Tertiary. The difference is that in the mesonychids the cusps are conoid rather than blade-shaped. The lower molars of mesonychids also emphasize the anteroposterior axis, with a prominent, anterad-directed paraconid, but the protoconid is a much larger cusp, with the metaconid more or less incorporated with it. The talonid continues the axis posterad, as it consists only of the hypoconid.

These molar patterns do not completely rule out the possibility of condylarth relationships for the Mesonychidae, but they supply little positive evidence for such affinities. The resemblances cited by Van Valen (1966, p. 103) between the mesonychids *Microclaenodon* and *Dissacus* and the arctocyonids *Goniacodon* and *Eoconodon* consists mainly of a moderate robustness. In these arctocyonids the protoconid and metaconid are relatively close together, but the paraconid is reduced and directed more linguad than anterad. There is a distinct hypocone. In short, although the relationships of the Mesonychidae are still uncertain, there is no conclusive evidence that they are condylarths or that they do not have affinities with the creodonts.

The molars of the Oxyaenidae and Hyaenodontidae are clearly derived from protocarnivore teeth. The paraconid is an anteroposteriorly directed

blade, almost as high and as long as the protoconid blade. The metaconid and talonid are reduced or lost. In the upper molars the paracone, metacone, and metastyle form a continuous anteroposterior blade, and the protocone, if present, is a narrow, heel-like linguad projection.

The derivation of the Oxyaenidae and Hyaenodontidae from the Palaeoryctidae is one of the arguments put forth by Van Valen (1966) for the establishment of the order Deltatheridia. This derivation is plausible for the upper molars, for there is no hypocone and the paracone and metacone are large. But there is a large stylar shelf that would have to be discarded in the transition to the creodonts. The evidence of the lower molars make any idea of close relationships between the palaeoryctids and the oxyaenids and hyaenodontids untenable. The degeneration of the paraconid in the palaeoryctids is comparable with that in the zalambdodonts. It is inconceivable that such a vestige could have given rise to the paraconid of oxyaenids and hyaenodontids. Only what I have called here the protocarnivore molar could have produced the "Pseudocreodi" tooth, and the nearest thing to the ideal protocarnivore dentition is that of the early miacids. Therefore I regard the Miacidae, notwithstanding their "modern" aspect, as being the stem group from which the Carnivora developed, and I retain the traditional division into Fissipeda and Creodonta, the latter consisting of the Oxyaenidae and Hyaenodontidae, and tentatively the Mesonychidae.

Family Hyaenodontidae Leidy, 1869
Genus *Hyaenodon* Laizer and Parieu, 1838
Type species: *Hyaenodon leptorhynchus* Laizer and Parieu, 1838

GENERIC CHARACTERS

Creodonts of medium size, superficially wolf-like. Skull relatively long, the facial region longer than the cranial; prominent sagittal and lambdoidal crests. Dentition $\frac{3142}{3143}$; canines large, cycloid in cross section; all premolars triangular blades, with rudimentary heel on 3rd and 4th; P^4 with inner root; M^1 and M^2 blade-shaped, with an anterior crest formed by paracone and metacone, which are more or less confluent, especially on M^2; protocone represented only by a linguad protrusion of base of crown at anterolingual angle; M^2 rooted in anterior base of zygoma; P_4 higher than M_1; lower molars progressively larger and more trenchant from M_1 to M_3; sectorial blade formed by paraconid and protoconid, with no trace of metaconid; vestigial talonid on M_1 and M_2, absent on M_3; DP $\frac{4}{4}$ molariform.

? *Hyaenodon horridus* Leidy, 1853

REMARKS

The Royal Ontario Museum expedition of 1948 obtained from the Hunter Quarry the incomplete mandibular ramus of *"Hyaenodon* sp., near *H. horridus*" (Russell, 1950, p. 55). Unfortunately, after the ROM collection was taken to Ottawa in 1950 so that I could continue my studies, this specimen was lost. All that can be said at this time is that there is a large-sized species of *Hyaenodon* in the Cypress Hills fauna.

Hyaenodon cruentus Leidy, 1853

Fig. 11E.

REFERENCES

Leidy, 1853, p. 393; Lambe, 1908, pp. 56, 57, pl. 7, figs. 1–3; Scott and Jepsen, 1936, pp. 47–50, pl. 9, figs. 1–5, pl. 22, figs. 5, 6.

REFERRED SPECIMENS. NMC: 6493, anterior fragment of left mandibular ramus with roots of C-M_1, Bone Coulee; 6494, left P_2, Bone Coulee; 8824, left M_1, collected by E. C. Neese, Shaunavon.

SPECIFIC CHARACTERS

Relatively large but about one-quarter to one-third smaller than *H. horridus*. Postorbital constriction of cranium well forward; facial region high, as in *H. horridus*. Angular process of mandible well developed. (Based on Scott and Jepsen, 1936.)

DESCRIPTION

NMC 6493 and 6494 were adequately described by Lambe (1908). NMC 8824 is an almost unworn tooth with the posterior root missing. The paraconid is almost conoid, and its crest is slightly oblique, as compared with the much higher protoconid crest. The hypoconid is not much lower than the paraconid but is more trenchant. Dimensions: anteroposterior, 13.9 mm; transverse, 9.0 mm.

REMARKS

Scott and Jepson (1936) expressed doubts as to the distinctiveness of this species from *H. horridus*. The three Cypress Hills specimens fall within the size ranges given by those authors for *H. cruentus*.

Hyaenodon mustelinus Scott, 1895

Fig. 11F-I.

REFERENCES

Scott, 1895, pp. 499, 500; Scott and Jepson, 1936, p. 53, pl. 8, pl. 9, figs. 6, 11, pl. 16.

REFERRED SPECIMENS. NMC: 6495, left P^4, and 9199, right DP^3, from Conglomerate Creek Valley; 8640, left M^1, Calf Creek valley.

SPECIFIC CHARACTERS

Smallest of the American species. Postorbital constriction immediately behind orbit. Anterior ends of nasals not notched. Scapula with T-shaped acromium. Femur with distinct third trochanter. (Scott and Jepsen, 1936.)

DESCRIPTION

NMC 6495 was doubtfully referred by Lambe (1908, p. 60) to *H.*

crucians Leidy. In size it agrees more closely with the P^4 of *H. mustelinus,* the length of which was given by Scott and Jepsen as 10.0 mm. The length of NMC 6495 is 10.4 mm, not 10.16 mm as given by Lambe. Length of the P^4 of *H. crucians* was given by Scott and Jepson as 12.0 mm. Lambe's description of NMC 6495 is adequate; he mentioned the well-developed inner cusp (deuterocone), which is more distinct than is usual for the P^4 of *Hyaenodon.*

NMC 9199 agrees closely with the description of the DP^3 of *H. crucians* as given by Scott and Jepsen. The tooth has, in addition to the principal cusp, one anterior smaller cusp and two posterior cusps that together form a trenchant ridge. There is an inner buttress and root, approximately opposite the first posterior cusp. The length of the specimen is 9.4 mm, which is much too small for the DP^3 of *H. crucians.* It is, however, similar to the antero-posterior dimension of the P^3 of *H. mustelinus*, and for that reason the specimen is referred to this species.

NMC 8640 was erroneously identified by me (Russell, 1934) as a left M_1. It is clearly an upper molar, as shown by the vestiges of three roots. That it is M^1 is indicated by the double nature of the main cusp, the paracone vestige being smaller than the metacone but still clearly defined. Although slightly smaller than the corresponding tooth of *H. mustelinus*, the specimen is more similar in size to that species than to any other described species. Dimensions: anteroposterior, 9.3 mm; transverse, 5.3 mm.

Cf. *Hyaenodon? minutus* Douglass, 1901

Fig. 13F,G.

REFERRED SPECIMENS. NMC: 9353, right M^2; 9354, left M^2; Calf Creek valley.

DESCRIPTION

These two teeth, from the Fenley Hunter collection, represent a small hyaenodont analogous to, and perhaps identical with, that called *Hyaenodon minutus* by Douglass (1901, p. 19), from Pipestone Springs. The Cypress Hills specimens have a conoid anterior cusp and a trenchant metastyle. Dimensions of the right molar are: anteroposterior, 8.1 mm; transverse, 3.9 mm. Both are imperfect at the anterobuccal angle, but the anterolingual spur (vestigial protocone) is obviously absent. These molars are therefore not from the same species as the maxillary fragment described by Matthew (1903, p. 208) as ?*Pseudopterodon minutus* (Douglass). On that specimen the apparent dimensions of the M^1 are so much smaller than those given by Douglass for the type (M_2) that it is doubtful that the two specimens from Pipestone Springs represent the same species. The two Cypress Hills teeth, however, are about the right size to be associated with the type of *H. minutus*, especially as they are M^2. Structurally they have the characteristics of the M^2 of *Hyaenodon.* Therefore if they really represent Douglass's species, it could

properly be assigned to *Hyaenodon* in spite of the small size. In removing the species from that genus, Matthew was influenced by the presence of a prominent anterolingual spur on the M^1 of his specimen, which he assumed to represent *H. minutus*.

Genus *Hemipsalodon* Cope, 1885
Type species: *Hemipsalodon grandis* Cope, 1885

GENERIC CHARACTERS

Creodonts of large size, superficially bear-like. Skull short and wide in facial region, elongate in cranial; outline in dorsal view ovoid rather than triangular; sagittal crest weak; external narial opening large and retreating; postorbital region bulging rather than constricted. Dentition $\frac{3133}{3143}$, massive and blunt; cheek teeth crowded, with first tooth above and below offset; M^3 transversely orientated but not much smaller than M^1. (Based mostly on Russell, 1938.)

REMARKS

Schlaikjer (1935) described *Hemipsalodon cooki* from the Yoder Formation of Wyoming, based on an anterior portion of a left mandibular ramus. This specimen is smaller than the corresponding part of *H. grandis* and does not show the anterior crowding of the dentition. The latter feature would exclude it from *Hemipsalodon* on the basis of the above definition. The genus has also been reported from the Vieja of Texas and the Clarno of Oregon. However, until it is shown that these specimens conform to the essential characteristics described above, I shall regard the genus as monotypic.

Hemipsalodon grandis Cope, 1885

Fig. 17G.

REFERENCES

Cope, E. D., 1885, p. 163; 1891, p. 6, pls. 2, 3. Lambe, 1908, p. 61, pl. 7, figs. 7, 8. Russell, 1934, p. 55, pl. 7, fig. 1; 1938, pp. 61–66, pls. 1–5.

TYPE. NMC 6497, incomplete right mandibular ramus with M_3.

REFERRED SPECIMENS. NMC 6498, right femur; NMC 6499, left femur; NMC 6496, canine; NMC 8641, left maxillary fragment with M^1–M^3; NMC 8791, incomplete skull with all incisors, both canines, and complete right check series. From Conglomerate Creek and Calf Creek valleys.

SPECIFIC CHARACTERS

As for the genus.

DESCRIPTION

Russell (1938, p. 61) described NMC 8791 as follows. "The specimen ... is an incomplete and somewhat crushed skull, lacking the occipital and most

of the basicranial region, and the left zygoma. The left maxilla is incomplete, but the right is well preserved, and retains at least portions of all of the maxillary teeth. The general form of the skull is remarkable for the pronounced shortening and broadening of the facial region, while the cranial region appears actually elongated. The broadening is most marked at the anterior margin of the skull.

"The formula of the upper dentition is 3.1.3.3. All of the teeth are relatively robust and blunt, and there are indications of crowding in both the incisor and cheek-teeth series. There is considerable evidence of wear, as well as the post-mortem damage. The incisors in their worn condition appear as blunt pegs, flattened from side to side. The I^3 is much larger than the two median I, and shows a facette of wear on the external side. The incisor series forms a slightly convex line, curving outward and downward at the midline. The canine is very massive, and blunter than in the Ursidae. It is broadly ovoid in cross section, with the long axis of the oval from front to rear. It projects obliquely forward and downward, and the anterior extremity is about as far advanced as the extremity of the incisor series. There is a large facette of wear on the inner side, extending up beyond the margin of the crown. A slight diastema is present between I^3 and C, to accommodate the lower canine. At the canine the dental series turns directly backward, but swings out somewhat in the molar region to parallel the zygomatic process. There is no trace of P^1. P^2 is a double-rooted tooth, set decidedly obliquely to the dental axis. From these evidences of crowding it appears that the shortness of the face is a true abbreviation, and not merely a relative broadening. P^3 is narrow and rather suggestive of the entelodont premolar; P^4 is larger, and has the heel more expanded. The molars are poorly preserved, and do not add much to the information on these teeth given elsewhere [Russell, 1934], except that they do not project as much from the maxilla as in the previously described specimen [NMC 8641].

	mm
Distance from I^1 to I^3 (right side)	27.3
Maximum diameter of canine	34.5
Distance from P^2 to P^4	57.7
Distance from M^1 to M^3	59

"The external narial opening is broadly expanded, in keeping with the facial proportions, and extends far back at a relatively low angle to the dorsal outline of the skull. This gives a bear-like appearance to the nostrils, quite in contrast to *Hyaenodon*. The *nasal* bones are rather broad, and they extend back about as far at the postorbital process. The anterior or narial margin of the nasal bone runs obliquely back from the premaxilla to the midline, continuing the broadly ovoid outline of the nares, as in the Canidae, and the median projection seen in *Hyaenodon*, the Ursidae, etc., appears to be completely absent. The *premaxilla* is not unusual; its posterior process is much as in *Hyaenodon*, but its alveolar portion is relatively wider. The *maxilla* bulges prominently over the canine root, contracts behind it, and swells out again in the zygomatic region. There is a large infraorbital foramen, separated into a lower, and a slightly smaller upper canal by an oblique

septum. The *frontal* is large and swollen, bulging at the postorbital prominence, which is broad and rounded, not at all pointed or overhanging. From this prominence the line of attachment of the temporal muscle curves inward and backward to meet its fellow in the vicinity of the fronto-parietal suture and form the sagittal crest. In front of this juncture the interfrontal suture lies in a distinct sulcus. Anteriorly the frontal ends abruptly against the maxilla, and does not send a branch forward toward the premaxilla, as in *Hyaenodon* and most of the fissipeds. The *parietal*, as preserved, is distinctly concave, especially posteriorly (temporal fossa), but the sagittal crest is not elevated, and does not seem to have formed anything like the great posterior eminence seen in *Hyaendon.* The fronto-parietal suture is obscure, but appears to run backward from the midline a little behind the anterior end of the sagittal crest. The suture of the *jugal* and the maxilla is not unusual; it runs obliquely backward and downward from the lachrymal region, apparently steepening at the last. The *lachrymal* is crushed and obscure, as are the other bones of the orbital region.

"The brain case is crushed and shattered, but not enough to destroy its peculiar shape. It is very broad and swollen in the postorbital region and tapers gradually toward the occiput. This is more than a mere continuation of the facial broadening, because in creodonts the posterior facial and anterior cranial widths may be quite different. The condition in *Hemipsalodon* probably indicates greatly expanded olfactory lobes, as might be expected from the large size of the nasal passage.

	mm
Length of skull, as preserved	402
Maximum width of skull at anterior margin	112 "

Suborder Fissipeda Blumenbach, 1791
Family Canidae Gray, 1821
Genus *Daphoenus* Leidy, 1853
Type species: *Daphoenus vetus* Leidy, 1853

GENERIC CHARACTERS

Medium-sized canids. Skull with short, narrow face, and elongate cranium; tympanic bullae relatively small, loose; sagittal crest high, occipital outline triangular. Dentition $\frac{3143}{3143}$. Upper incisor row much narrower than space between canines, the teeth increasing in size from I^1 to I^3; P^4 with relatively large anterolingual cusp (deuterocone); upper molars regularly decreasing in size from M^1 to M^3; M^1 and M^2 with moderate hypocone shelf, not oblique; M^3 small, ovoid. Lower incisors small, close-set; M_1 with paraconid oblique, metaconid relatively large. M_2 with small but distinct paraconid; M_3 relatively large for a canid.

REMARKS

This genus structurally, and perhaps phylogenetically, forms a link between the Miacidae and the Canidae, as demonstrated not only by the presence of M^3 but also by the relatively primitive structure of P^4, M^1, and M_1.

Daphoenus canadensis Russell, 1934

Fig. 12A-C

REFERENCES

Daphoenus felinus, Lambe, 1908, p. 62, pl. 7, figs. 15, 16; *Daphoenus canadensis*, Russell, 1934, p. 56.

TYPE. NMC 6512, portion of right maxilla with P^4.

REFERRED SPECIMENS. NMC 9026, right M_2; locality 128, Hunter collection.

SPECIFIC CHARACTERS

Somewhat larger than *D. vetus*. P^4 with anterolingual spur (deuterocone) prominent, with median ridge; no cingulum on anterobuccal angle of crown.

DESCRIPTION

The type specimen was well described by Lambe (1908). The M_2 (NMC 9206) is referred to this species on the basis of size, which is about the same as that of the M_2 in *Canis latrans*. The protoconid and metaconid are well separated, and the paraconid, although small, is distinct. The anterior cingulum projects anterad in front of the protoconid. Dimensions: anteroposterior, 9.6 mm; transverse, 6.8 mm.

REMARKS

D. canadensis was established as distinct from *D. felinus* (= *D. vetus*) because of the relatively large size of the P^4 and the greater prominence of the deuterocone. Its size, however, is not much greater than that of the P^4 of *D. vetus*, as quoted from Hatcher by Scott and Jepsen (1936, p. 77). On the basis of the prominent deuterocone and other peculiarities, the species is retained as distinct pending the discovery of additional material. The referred M_2 is also slightly larger than the corresponding tooth in *D. vetus*, which is the reason for tentatively including it in *D. canadensis*.

Daphoenus lambei Russell, 1934

Fig. 12D-H

REFERENCES

Protemnocyon hartshornianus, Lambe, 1908, p. 63, pl. 7, figs. 17–20; *Daphoenus lambei*, Russell, 1934, p. 56.

TYPE. NMC 6513, left P^4.

REFERRED SPECIMENS. NMC 6310, left P^4; 9207, left M^1; 9114, left M_1; 9200, right M_1. ROM 6331, right M^1. Various localities in Conglomerate Creek and Calf Creek valleys.

SPECIFIC CHARACTERS

Smaller than *D. hartshornianus*. P^4 narrow and elevated, with prominent deuterocone and continuous cingulum. Referred M^1 with a relatively prominent hypocone shelf.

DESCRIPTION

The type and the referred P^4 were described adequately by Lambe (1908). On the M^1 (NMC 9207) the three principal cusps are arranged in a broad triangle, but the large, basined hypocone shelf projects linguad rather than posterolinguad, making the tooth insectivore-like. Dimensions: anteroposterior, 7.2 mm; transverse, 10.6 mm. The other M^1 (ROM 6331) is similar but slightly larger, with the same development and arrangement of the principal cusps but with the hypocone shelf directed more posterolinguad. Dimensions: anteroposterior, 8.0 mm; transverse, 12.3 mm. Of the two lower molars, NMC 9114 is unworn and shows the typical structure of this tooth in *Daphoenus*, except that the talonid is slightly narrower. Dimensions of NMC 9114: anteroposterior, 11.9 mm; transverse, 6.2 mm.

REMARKS

The two P^4s described and figured by Lambe as of *D. hartshornianus* were removed to a new species because of the smaller size, the prominent deuterocone, and the well-developed cingulum (Russell, 1934). The four molar teeth are referred to this species because they too are slightly smaller than the corresponding teeth of *D. hartshornianus*.

Daphoenus cf. *vetus* Leidy, 1853

Fig. 13A,B

REFERRED SPECIMEN. NMC 9205, left mandibular fragment with P_2-M_2. Locality 133, Hunter collection.

DESCRIPTION

The premolar series is closely spaced. These teeth have the large, trenchant main cusp, with one small anterior cusp and two posterior cusps. P_3 is considerably larger than P_2; P_4 is longer but not as high as P_3. The M_1 is damaged along the lingual side. It was evidently a laterally compressed tooth, with an anterad-produced paraconid, which makes it resemble an enlarged M_1 of *Hesperocyon*. M_2, although small, is slightly trenchant, the protoconid being elevated and the metaconid reduced. Dimensions: P_2, anteroposterior, 7.5 mm, transverse, 3.5 mm; P_3, anteroposterior, 9.9 mm, transverse, 4.8 mm; P_4, anteroposterior, 12.0 mm, transverse, 5.2 mm; M_1, anteroposterior, 16.5 mm; M_2, anteroposterior, 8.3 mm, transverse, 4.4 mm.

REMARKS

Although the size of this specimen is similar to that of the mandible of *D. vetus*, the teeth are narrower and more trenchant than in that species.

Daphoenus cf. *hartshornianus* (Cope), 1873

Fig. 13C,D

REFERRED SPECIMEN. ROM 6333, right P^4; Calf Creek valley.

DESCRIPTION

This tooth agrees in size with the P^4 of *D. hartshornianus*, as described by

Scott and Jepsen (1936, p. 78). The cingulum is continuous except for a short gap at the extreme posterior. It differs from the P^4 of *D. lambei* in the larger size and the less protruding deuterocone with a much less prominent median crest. Dimensions: anteroposterior, 14.9 mm; transverse, 7.6 mm.

Daphoenus? sp.

Fig. 13E

REFERRED SPECIMEN. ROM 6332, left M^1; Conglomerate Creek valley.

DESCRIPTION

This is a small tooth, about the size of the M^1 in *Hesperocyon gregarius*. In structure, however, it is a miniature of the M^1 (NMC 9207) of *Daphoenus lambei*. The very large hypocone shelf projects almost directly linguad, a characteristic feature of *Daphoenus*. Dimensions: anteroposterior, 4.3 mm; transverse, 7.0 mm.

Genus *Hesperocyon* Scott, 1890
Type species: *Canis gregarius* Cope, 1873

GENERIC CHARACTERS

Small canids. Skull with short facial region, large fixed tympanic bullae, and moderately elevated sagittal crest. Dentition $\frac{3142}{3143}$. Upper incisor series nearly as wide as space between canines; slight increase in size from I^1 to I^3. P^4 with a relatively small deuterocone. Upper molars with small, posterolingual hypocone shelf; M^2 much smaller than M^1. Lower incisors small, close set. M_1 with paraconid orientated nearly anteroposterad; metaconid small but distinct; M_2 with paraconid merely the end of the protolophid; M_3 vestigial.

REMARKS

This genus has a curious nomenclatural history, as summarized by Scott and Jepsen (1936, p. 81) and by Green (1952). After the type species had been referred to the European genera *Amphicyon, Galecynus*, and *Cynodictis*, it was recognized by Schlosser (1902) as distinctive in the possession of large, fixed tympanic bullae and was made the type of the new genus *Pseudocynodictis*. This name was subsequently used by most authors, including W. B. Scott. But Green pointed out that Scott himself, in 1890, proposed the generic name *Hesperocyon* for "*Galecynus*" *gregarius*. *Hesperocyon*, therefore, has clear priority and is also very appropriate.

Hesperocyon gregarius (Cope), 1873

Fig. 13H,I; fig. 14; fig. 15; fig. 16A-F

REFERENCES

Canis gregarius, Cope, 1873. *Galecynus gregarius*, Cope, 1881. *Hesperocyon gregarius*, Scott, 1890. *Cynodictis gregarius*, Scott, 1898. *Pseudocynodictis gregarius*, Schlosser, 1902; Scott and Jepsen, 1936. *Cynodictis lippincottianus*, Lambe, 1908, p. 61, pl. 7, figs. 9–14.

SPECIFIC CHARACTERS

As for the genus.

REFERRED SPECIMENS. NMC: 9201, right P^4; 9127, 9128, right M^1; 6501, 6503, left P_3; 6502, left P_4; 9203, left M_1; 6500, 9204, right M_1; 9130, left M_2; 9202, mandibular fragment with right M_2. ROM: 6334, right P^4; 6338, left M^1; 6335, right M^1; 6340, 6387, left M^2; 1818, 6339, right M^2; 6336, 6337, left lower P; 6389, right lower P; 6342, left M_1; 6341, 6388, 6390, right M_1; 6343, 6344, 6345, left M_2; 6346, right M_2. Various localities in Conglomerate Creek and Calf Creek valleys.

DESCRIPTION

The right P^4 (NMC 9201) lacks the roots and is probably an unerupted tooth. The principal cusp is slender and high. Posterior to this cusp is a low, slightly trenchant cuspule, followed by a very small cuspule at the posterior angle of the crown. The anterior cuspule is low, merely an enlargement of the cingulum. The internal cusp (deuterocone) is well separated on a narrow spur. Compared with the P^4 of specimens from the White River Oligocene, this tooth is less robust, with a sharper main cusp and a more distinct deuterocone. Dimensions: anteroposterior, 7.4 mm; transverse, 5.1 mm. The other right P^4, ROM 6334, is somewhat more robust and is almost identical with corresponding teeth of *H. gregarius* from the Brulé of Nebraska. A minor difference is that the posterior portion of the Cypress Hills tooth is slightly wider proportionately, and the margins, instead of converging straight posterad, have an oblique truncation at the rear. Dimensions: anteroposterior as preserved, 8.9 mm; transverse, 4.4 mm.

Of the various M^1, NMC 9127 is a triangular tooth, with the posterolingual hypocone shelf relatively prominent. The buccal margin is very oblique to the transverse axis of the crown; the parastyle projects anterad and the metastyle posterad. The paracone and metacone are conoid, the paracone slightly larger. The protocone is prominent, with a V-shaped crest; it is nearer to the anterior than to the posterior margin. The protoconule is a small, bulbous cuspule at the end of the anterior arm of the protocone crest. The metaconule is less conspicuous, being incorporated in the posterior arm of the protocone crest. There is a distinct hypocone on the broadly rounded posterolingual shelf. This tooth is almost identical in size with M^1 from the Brulé of Nebraska. The crown pattern is also similar, but the parastyle, metastyle, and hypocone are more prominent on the Cypress Hills tooth. Dimensions: anteroposterior, 6.3 mm; transverse, 9.0 mm.

Another right M^1, NMC 9128, is smaller than NMC 9127. It also differs from NMC 9127 in having the buccal margin of the crown concave and the posterolingual shelf without a distinct, cuspate hypocone. In these features the tooth more closely resembles M^1 from the Brulé Formation, although noticeably smaller. Dimensions: anteroposterior, 4.9 mm; transverse, 6.6 mm. A somewhat larger right M^1, ROM 6335, is also similar to the Brulé specimens, especially in the moderate development of the hypocone. Dimensions: anteroposterior, 6.3 mm; transverse, 8.5 mm. The left M^1, ROM 6338, is about the size of NMC 9128, but has the oblique buccal margin of NMC

9127. Dimensions: anteroposterior, 4.9 mm; transverse, as preserved, 7.4 mm.

The right M^2, NMC 1818, is rounded-subtrigonal in outline. The buccal styles are not developed. The paracone and metacone are conoid, the paracone being the larger. The protocone is low and situated at the point of a V-shaped crest, the arms of which continue into the cingulum on the anterior and posterior margins. The intermediate cuspules are not distinct. The posterolingual expansion of the cingulum is without a distinct hypocone. This tooth resembles the M^2 from the Brulé Formation in size and structure. Dimensions: anteroposterior, 3.3 mm; transverse, 5.7 mm. Another right M^2, ROM 6339, has the protocone more centrally located and the buccal margin with a slight notch just in front of the metacone. Dimensions: anteroposterior, 3.3 mm; transverse, 5.7 mm. A left M^2, ROM 6387, has a convex buccal margin. Dimensions: anteroposterior, 3.6 mm; transverse, 6.1 mm. Distinctly smaller than the three previously mentioned teeth is ROM 6340, a left M^2. The crown is more ovoid in outline and the metastyle angle less distinct. Dimensions: anteroposterior, 2.5 mm; transverse, 4.8 mm.

Of the lower dentition, three premolars (ROM 6336, 6337, 6389) are not certainly identifiable as to position. One of these, ROM 6336, has two accessory cuspules on the posterior crest, the other having a single cuspule with an indication of a second. The other lower premolars are identified as P_3 (NMC 6501, 6503) and P_4 (NMC 6502). They were adequately described by Lambe (1908) but are figured here (Fig. 14H,I). A right M_1, NMC 6500, was also described by Lambe. All of these teeth are similar to the corresponding teeth of *H. gregarius* from the Brulé Formation. Another right M_1 that is similar in size and structure to that tooth in Brulé specimens is ROM 6388. Its dimensions are: anteroposterior, 9.2 mm; transverse, 4.0 mm. There is also a pair of M_1 (ROM 6341, 6342) that could be from one individual, except that the staining of the enamel is different. As compared with ROM 6388 and the Brulé specimens, these teeth have the paraconid slightly more oblique to the long axis of the crown, thus shortening the overall length relative to width. Dimensions of right M_1 (ROM 6341): anteroposterior, 8.8 mm; transverse, 4.2 mm. Dimensions of left M_1 (ROM 6342): anteroposterior, 8.1 mm; transverse, 4.1 mm.

A more aberrant tooth is NMC 9203, a left M_1. The protoconid is high, and from it the trenchant paraconid projects more anterad than linguad. The metaconid is small but distinct. On the posterobuccal slope of the protoconid there is a distinct stylar cusp, almost as large but not as high as the metaconid. The entoconid is the largest cusp on the talonid, but the hypoconid is only slightly smaller. Between entoconid and metaconid there is a distinct conulid, closing the gap in the wall of the talonid basin. A similar but much smaller conulid is present anterior to the hypoconid. All of the cusps are sharper and more elevated than in the Brulé specimens available for comparison. Dimensions: anteroposterior, 9.0 mm; transverse, 3.8 mm.

The M_2 is represented by six specimens, which vary considerably. NMC 9202, in place on a portion of the left mandibular ramus, is oval in outline.

The trigonid is relatively high and the three cusps close together. The paraconid is small but distinct and is near the midline of the tooth. The cingulum projects anterobuccad between protoconid and paraconid. The talonid is pointed posteriorly, suggesting a rudimentary hypoconulid. Dimensions: anteroposterior, 4.7 mm; transverse, 3.5 mm. In NMC 9130, a left M_2, the trigonid is low, forming a symmetrical V. The paraconid is vestigial. The prominent anterior cingulum is more rounded than in NMC 9202. The talonid is pointed posteriorly; the hypoconulid is distinct, but the entoconid is vestigial. Dimensions: anteroposterior, 4.5 mm; transverse, 2.9 mm. Other M_2 in the collections (ROM 6343, 6344, 6345) are similar to NMC 9130, except that in these the paraconid is more distinct, and is situated close to the lingual margin. ROM 6346 is more like NMC 9202, with the paraconid near the midline of the tooth, and the cingulum projecting anterolinguad. There is some variation in the height of trigonid relative to talonid among these lower molars. Dimensions of ROM 6344: anteroposterior, 4.6 mm; transverse, 2.9 mm.

Examples of M_3 of this species have not been recognized in the collections. NMC 9202 has a moderately large, single alveolus for this tooth.

REMARKS

Although there is much minor variation among the teeth described above, most are similar to the corresponding teeth of this species from the Brulé Formation. The more aberrant specimens are regarded tentatively as representing variant individuals.

Hesperocyon? spp.

Fig. 16G,H

REFERRED SPECIMENS. NMC 9129, right M_1; ROM 6347, right M^1.

DESCRIPTION

The M_1 is relatively small and short, with the paraconid projecting as much linguad as anterad. The metaconid and paraconid are subequal in size. The talonid is rounded-rectangular, bordered by a rim that is shallowly notched behind but without a distinct hypoconid or entoconid. Dimensions: anteroposterior, 6.9 mm; transverse, 3.6 mm. The M^1 is large, with a parastyle projecting more buccad than anterad. The protocone is close to the lingual margin, and the posterolingual shelf is small and without distinct hypocone. Dimensions: anteroposterior, 7.8 mm; transverse, 12.0 mm.

REMARKS

Although neither of these two specimens can be referred to *H. gregarius*, they represent opposite extremes. NMC 9129 is structurally similar to the M_1 of *Daphoenus* but is unusually small, even for *Hesperocyon*. ROM 6347 resembles the M^1 of *Hesperocyon* but is about the size of that tooth in *Daphoenus lambei*.

Genus *Daphoenocyon* Hough, 1948

Daphoenocyon? sp.

Fig. 17A,B

REFERRED SPECIMEN. ROM 6348, fragment of right mandibular ramus with M_1.

DESCRIPTION

The M_1 resembles the corresponding teeth of miacids, e.g., *Vulpavus* Marsh. For a canid the trigonid is low, with relatively blunt cusps. The protoconid is highest and the conoid metaconid lowest. The paraconid is directed more linguad than anterad. The talonid is short, rounded, and moderately basined; hypoconid and entoconid are poorly defined on the rim. Dimensions: anteroposterior, 6.5 mm; transverse, 3.7 mm.

REMARKS

Hough (1948, p. 594) proposed the genus *Daphoenocyon* for *Daphoenus dodgei* Scott (1898), distinguishing it, among other characters, by the "much more primitive" structure of the M_1, with rounded protoconid and relatively large metaconid. The present specimen agrees closely with the M_1 as described and figured by Scott and Jepsen (1936) and by Clark and Beerbower (1967) but is much smaller. The latter authors mention "a small species of *Daphoenocyon* from Pipestone Springs", but even in this the dimensions given for M_1 are almost twice those of ROM 6348.

Family Felidae Gray, 1821
Genus *Dinictis* Leidy, 1854
Type species: *Dinictis felina* Leidy, 1854

GENERIC CHARACTERS

Moderately large felids, with relatively elongate skulls. Dentition: $\frac{3131}{3132}$. Incisor series transverse to long axis of skull; no cingulum on I^3. Upper canines sabre-like but only moderately exaggerated. P^2 small, double-rooted; P^3 large, compressed, with single posterior cusp; P^4 larger than P^3, with large posterior blade and distinct deuterocone. M^1 small, narrow, orientated transversely, with three cusps in line. Lower canines relatively large, not premolariform. P_2 small, compressed-conoid, double-rooted; P_3 and P_4 compressed, with anterior and posterior accessory cusps but no posterior cingulum. M_1 with blade-like paraconid and pyramidoid protoconid; a vestigial metaconid in some individuals; small, trenchant talonid. M_2 small, single-rooted. (Based on Scott and Jepsen, 1936, p. 110.)

Dinictis felina Leidy, 1854

Fig. 17C-F

REFERENCES

Leidy, 1854, pp. 127, 156. Lambe, 1908, p. 64, pl. 7, figs. 21–24. Scott and Jepsen, 1936, p. 122, pls. 15, 22, figs. 3, 4.

REFERRED SPECIMENS. NMC 6472, incomplete upper canine; NMC 9355, right lower premolar, probably P_3; NMC 6475, right M_1.

SPECIFIC CHARACTERS

Species of this genus are distinguished mainly on the basis of size. *D. felina* is relatively large. (See Scott and Jepsen, 1936, p. 122, for typical dimensions.)

DESCRIPTION

The canine and the M_1 were well described by Lambe (1908). The molar is rootless and probably was unerupted, as is also suggested by the unworn edges of the cusps. Dimensions of the molar, not given by Lambe, are: anteroposterior, 20.8 mm; transverse, 8.6 mm. The premolar is typical of *Dinictis*; it has the large main cusp, triangular in side view, with much smaller anterior and posterior cusps. It could be either P_3 or P_4 but, because of the size, is probably the former. Dimensions: anteroposterior, 10.8 mm; transverse, 5.0 mm.

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Literature Cited

AYMARD, A.

1846 Essai monographique sur un nouveau genre de mammifère fossile trouvé dans la Haute-Loire, et nommé *Entelodon*, suivi d'un aperçu sur les gîtes fossilifères du départment. Annls. Soc. Agric. Puy, vol. 12, pp. 227–267, 1 pl.

1850 Concernant les restes de mammifères fossiles recueillis dans le calcaire miocène des environs du Puy. Annls. Soc. Agric. Puy, vol. 14, pp. 104–114.

BLACK, C. C.

1968 The Oligocene rodent *Ischyromys* and discussion of the family Ischyromyidae. Ann. Carneg. Mus., vol. 39, art. 18, pp. 273–305, figs. 1–26.

BLUMENBACH, J. F.

1791 Handbuch der Naturgeschichte. 4th ed. Göttingen, J. C. Dieterich. 749 pp., 3 pls.

BOWDICH, T. E.

1821 An analysis of the natural classification of Mammalia. Paris, J. Smith. 146 pp., 16 pls.

BURKE, J. J.

1935 *Pseudocylindrodon*, a new rodent genus from the Pipestone Springs Oligocene of Montana. Ann. Carneg. Mus., vol. 25, pp. 1–4, figs. 1–2.

BUTLER, P. M.

1956 The skull of *Ictops* and the classification of the Insectivora. Proc. Zool. Soc. Lond., vol. 126, pt. 3, pp. 453–481, figs. 1–8.

CLARK, J.

1936 *In* Scott and Jepsen, 1936, p. 22, pl. 2, figs. 5, 5a.

1937 The stratigraphy and paleontology of the Chadron Formation in the Big Badlands of South Dakota. Ann. Carneg. Mus., vol. 25, art. 21, pp. 261–350, figs. 1–12, pls. 21–26.

1966 Status of the generic names *Metacodon* and *Geolabis*. J. Paleont., vol. 40, pp. 1248–1251.

CLARK, J., and J. B. BEERBOWER

1967 Geology, paleoecology, and paleoclimatology of the Chadron Formation. *In* Clark, J., J. R. Beerbower, and K. K. Kietze. Oligocene sedimentation, stratigraphy, paleoecology and paleoclimatology of the Big Badlands of South Dakota. Fieldiana, Geol. Mem., vol. 5, pp. 21–74, figs. 9–29.

COPE, E. D.

1873 Third notice of extinct Vertebrata from the Tertiary of the Plains. Palaeont. Bull., no. 16, pp. 1–8.

1875 On the supposed Carnivora of the Eocene of the Rocky Mountains. Proc. Acad. Nat. Sci. Philad., 1875, pp. 444–448.

1881 On the genera of the Creodonta. Proc. Am. Phil. Soc., vol. 19, pp. 76–82.

1884 The Vertebrata of the Tertiary Formations of the West. Book I. Rep. U. S. Geol. Surv. Terr., vol. 3, 1009 pp., 131 pls.

1885 The White River beds of Swift Current River, Northwest Territory. Am. Nat., vol. 19, no. 2, p. 163.

1891 On Vertebrata from the Tertiary and Cretaceous rocks of the North West Territory. I. The species from the Oligocene or Lower Miocene beds of the Cypress Hills. Contr. Can. Palaeont., vol. 3 [pt. 1], pp. 1–25, 14 pls.

DAWSON, M. R.

1958 Later Tertiary Leporidae of North America. Paleont. Contr., Univ. Kans., art. 6, pp. 1–75, 39 figs., 2 pls., 12 tables.

1967 Lagomorph history and the stratigraphic record. *In* Teichert, C. and E. L. Yochelson, eds. Essays on paleontology and stratigraphy; R. C. Moore commemorative volume. Spec. Publ. Univ. Kans., Dept. Geol., 2, pp. 287–316, figs. 1–6.

DEPÊRET, C. and H. DOUXAMI

1902 Les vertébrés oligocènes de Pyrimont-Challonges (Savoie). Abh. Schweiz. Paläont. Ges., vol. 29, no. 1, pp. 1–91, 7 figs., 6 pls.

DOUGLASS, E.

1901 Fossil Mamalia of the White River beds of Montana. Trans. Am. Phil. Soc., n.s., vol. 20, pp. 237–279, pl. 9.

FURNIVAL, G. M.

1946 Cypress Lake map-area, Saskatchewan. Mem. Geol. Surv. Can., mem. 242, pp. 1–161, 5 figs., 4 pls., 2 maps.

GALBREATH, E. C.

1953 A contribution to the Tertiary geology and paleontology of northeastern Colorado. Paleont. Contrib. Univ. Kans., art. 4, pp. 1–120, figs. 1–26, pls. 1, 2.

GRAY, J. E.

1821 On the natural arrangement of vertebrose animals. Lond. Med. Repository, vol. 15, pp. 296–310.

GREEN, M.

1952 *Hesperocyon* Scott 1890 for *Pseudocynodictis* Schlosser 1902. J. Paleont., vol. 26, no. 1, p. 124.

HAY, O. P.

1899 Notes on the nomenclature of some North American fossil vertebrates. Science, ser. 2, vol. 10, pp. 253–254.

HOUGH, J. R.

1948 A systematic revision of *Daphoenus* and some allied genera. J. Paleont., vol. 22, no. 5, pp. 573–600, figs. 1–3, pls. 1–4.

1961 Review of Oligocene didelphid marsupials. J. Paleont., vol. 35, no. 1, pp. 218–228, figs. 1, 2.

HOUGH, J. R. and R. ALF

1956 A Chadron mammalian fauna from Nebraska. J. Paleont., vol. 30, no. 1, pp. 132–140, figs. 1–4.

HOWE, J. A.

1966 The Oligocene rodent *Ischyromys* in Nebraska. J. Paleont., vol. 40, no. 5, pp. 1200–1210, figs. 1–3.

LAIZER, L. DE and DE PARIEU

1838 Description et determination d'une machoire fossile appartenant à un mammifère jusqu'a present inconnu, *Hyaenodon leptorhynchus*. C. R. Acad. Sci. Paris, vol. 7, p. 442.

LAMBE, L. M.
1908 The Vertebrata of the Oligocene of the Cypress Hills, Saskatchewan. Contr. Can. Palaeont., vol. 3, pt. 4, pp. 1–64, 13 figs., 8 pls.

LAVOCAT, R.
1951 Révision de la faune des mammifères Oligocènes d'Auvergne et du Velay. Paris, Éditions "Sciences et Avenir." 153 pp., 26 pls., 1 map.

LEIDY, J.
1853 [Remarks on a collection of fossil Mammalia from Nebraska]. Proc. Acad. Nat. Sci. Philad., vol. 6, no. 10, pp. 392–394.
1854 [Remarks on a new species of mammal from Nebraska. *Dinictis felina*]. Proc. Acad. Nat. Sci. Philad., vol. 7, no. 4, p. 127.
1856 Notice of remains of extinct Mammalia, discovered by Dr. F. V. Hayden in Nebraska Territory. Proc. Acad. Nat. Sci. Philad., vol. 8, no. 2, pp. 88–90.
1868 Notice of some remains of extinct Insectivora from Dakota. Proc. Acad. Nat. Sci. Philad., 1868, pp. 315–316.
1869 The extinct mammalian fauna of Dakota and Nebraska including an account of some allied forms from other localities, together with a synopsis of the mammalian remains of North America. J. Acad. Nat. Sci. Philad., ser. 2, vol. 7, pp. 23–472, pls. 1–29.

MATTHEW, W. D.
1903 The fauna of the Titanotherium beds at Pipestone Springs, Montana. Bull. Am. Mus. Nat. Hist., vol. 19, pp. 197–226, figs. 1–19.
1905 Notice of two new genera of mammals from the Oligocene of South Dakota. Bull. Am. Mus. Nat. Hist., vol. 21, pp. 21–26, figs. 1–6.
1909 The Carnivora and Insectivora of the Bridger Basin, Middle Eocene. Mem. Am. Mus. Nat. Hist., n.s., vol. 9, pt. 6, pp. 291–567, figs. 1–118, pls. 43–52.
1910 On the osteology and relationships of *Paramys*, and the affinities of the Ischyromyidae. Bull. Am. Mus. Nat. Hist., vol. 28, pp. 43–71, figs. 1–19, pls. 1–5.
1915 A revision of the Lower Eocene Wasatch and Wind River faunas. Part I. Order Ferae (Carnivora) Suborder Creodonta. Bull. Am. Mus. Nat. Hist., vol. 34, pp. 1–103, figs. 1–87.

MATTHEW, W. D. and W. GRANGER
1923 Nine new rodents from the Oligocene of Mongolia. Am. Mus. Novit., no. 102, pp. 1–10, figs. 1–12.

MC CONNELL, R. G.
1885 Report on the Cypress Hills, Wood Mountain and adjacent country. Rep. Geol. Surv. Can., n.s., vol. 1, rep. C, pp. 1–85, 3 pls., 1 map.

MC GREW, P. O.
1937 New marsupials from the Tertiary of Nebraska. J. Geol., vol. 45, no. 4, pp. 448–455, figs. 1–4.
1939 *Nanodelphys*, an Oligocene didelphine. Publs. Field Mus. Nat. Hist., vol. 6, no. 26, pp. 393–400, fig. 114.

MC KENNA, M. C.
1960 The Geolabidinae a new subfamily of Early Cenozoic erinaceoid insectivores. Univ. Calif. Publs. Geol. Sci., vol. 37, pp. 131–164, figs. 1–6.

MC LEARN, F. H.
1928 Stratigraphy, structure, and clay deposits of Eastend area, Cypress Hills, Saskatchewan. Summ. Rep. Geol. Surv. Can., 1927, pt. B, pp. 21–53, 1 map.

MILLER, G. S. and J. W. GIDLEY
1918 Synopsis of the supergeneric groups of rodents. J. Wash. Acad. Sci., vol. 8, no. 13, pp. 431–448.
1920 A new fossil rodent from the Oligocene of South Dakota. J. Mammal., vol. 1, no. 2, pp. 73–74.
PATTERSON, B. and P. O. MC GREW
1937 A soricid and two erinaceids from the White River Oligocene. Publs. Field Mus. Nat. Hist., vol. 6, pp. 245–272, figs. 1–74.
1962 A new arctocyonid from the Paleocene of Wyoming. Breviora, no. 174, pp. 1–10, figs. 1–3.
ROCHEBRUNE, A. T. DE
1883 Faune de la Sénégambie. Mammifères. Act. Soc. Linn. Bordeaux, vol. 37, pp. 47–203, pls. 4–12.
RUSSELL, L. S.
1934 Revision of the Lower Oligocene vertebrate fauna of the Cypress Hills, Saskatchewan. Trans. R. Can. Inst., vol. 20, pt. 1, no. 43, pp. 49–67, pls. 7–10.
1938 The skull of *Hemipsalodon grandis*, a giant Oligocene creodont. Trans. R. Soc. Can., ser. 3, vol. 32, sec. 4, pp. 61–66, pls. 1–5.
1940 Titanotheres from the Lower Oligocene Cypress Hills Formation of Saskatchewan. Trans. R. Soc. Can., ser. 3, vol. 34, sec. 4, pp. 89–100, pls. 1–5.
1950 The Tertiary gravels of Saskatchewan. Trans. R. Soc. Can., ser. 3, vol. 44, sec. 4, pp. 51–59.
1954 Evidence of tooth structure on the relationships of the early groups of Carnivora. Evolution, vol. 8, no. 2, pp. 166–171, figs. 1–7.
1959 The dentition of rabbits and the origin of the Lagomorpha. Bull. Natn. Mus. Can., no. 166, pp. 41–45, figs. 1–3.
1962 Mammal teeth from the St. Mary River Formation (Upper Cretaceous) at Scabby Butte, Alberta. Nat. Hist. Pap. Natn. Mus. Can., no. 14, pp. 1–4, figs. 1–6.
1965 Tertiary mammals of Saskatchewan. Part I. The Eocene fauna. Life Sci. Contr., R. Ont. Mus., no. 67, pp. 1–33, 7 pls.
SCHLAIKJER, E. M.
1935 Contributions to the stratigraphy and palaeontology of the Goshen Hole Area, Wyoming. III. A new basal Oligocene formation. Bull. Mus. Comp. Zool. Harv., vol. 76, pp. 71–93, figs. 1–10, pls. 1–9.
SCHLOSSER, M.
1902 Beiträge zur Kenntnis der Säugetierreste aus den süddeutschen Bohnerzan. Geol. Paläont. Abh., n.s., band 5, heft 3, pp. 117–258, pls. 1–5.
SCOTT, W. B.
1890 The dogs of the American Miocene. Princeton Coll. Bull., vol. 2, pp. 37–39.
1895 The osteology of *Hyaenodon*. J. Acad. Nat. Sci. Philad., ser. 2, vol. 9, pp. 499–536, figs. 1–10.
1898 Notes on the Canidae of the White River Oligocene. Trans. Am. Phil. Soc., n.s., vol. 19, pp. 325–415, pls. 19, 20.
1941 Part v. Perissodactyla. *In* Scott, W. B., G. L. Jepsen, and A. E. Wood. The mammalian fauna of the White River Oligocene. Trans. Am. Phil. Soc., n.s., vol. 28, pt. 5, pp. 747–980, figs. 137–157, pls. 79–100.

SCOTT, W. B. and G. L. JEPSEN

1936 Part I. Insectivora and Carnivora. *In* Scott, W. B., G. L. Jepsen, and A. E. Wood. The mammalian fauna of the White River Oligocene. Trans. Am. Phil. Soc., n.s., vol. 28, pt. 1, pp. 1–153, figs. 1–7, pls. 1–22.

SIMPSON, G. G.

1928 American Eocene didelphids. Am. Mus. Novit., no. 397, pp. 1–7, figs. 1–5.

VAN VALEN, L.

1966 Deltatheridia, a new order of mammals. Bull. Am. Mus. Nat. Hist., vol. 132, art. 1, pp. 1–126, figs. 1–17, pls. 1–8.

VONHOF, J. A.

1965 The Cypress Hills Formation and its reworked deposits in southwestern Saskatchewan. Alberta Soc. Petrol. Geol., 15th A. Fld. Conf. Guidebook, pt. 1, pp. 142–161, figs. 1–10, pl. 1 [map].

WALKER, M. V.

1931 Notes on North American fossil lagomorphs. The Aerend, vol. 2, pp. 227–240, pl. 1.

WILLIAMS, M. Y. and W. S. DYER

1930 Geology of southern Alberta and southwestern Saskatchewan. Mem. Geol. Surv. Can., 163, pp. 1–160, 4 figs., 5 pls., 1 map.

WOOD, A. E.

1937 Part II. Rodentia. *In* Scott, W. B., G. L. Jepsen, and A. E. Wood. The mammalian fauna of the White River Oligocene. Trans. Am. Phil. Soc., n.s., vol. 28, pt. 2, pp. 155–269, figs. 8–70, pls. 23–33.

1940 Part III. Lagomorpha. *In* Scott, W. B., G. L. Jepsen, and A. E. Wood. The mammalian fauna of the White River Oligocene. Trans. Am. Phil. Soc., n.s., vol. 28, pt. 3., pp. 271–362, figs. 71–116, pls. 34, 35.

1969 Rodents and lagomorphs from the "Chadronia Pocket," Early Oligocene of Nebraska. Am. Mus. Novit., no. 2366, pp. 1–18, figs, 1, 2, 3 tables.

WOOD, A. E. and R. W. WILSON

1936 A suggested nomenclature for the cusps of the cheek teeth of rodents. J. Paleont., vol. 10, no. 5, pp. 388–391, figs. 1–2.

WORTMAN, J. L.

1901 Studies of Eocene Mammalia in the Marsh Collection, Peabody Museum. Part I. Carnivora. Am. J. Sci., ser. 4, vol. 11, pp. 333–348, 437–450, figs. 1–6, pls. 5, 6.

Fig. 1: all ×8.

A. *Peratherium valens* (Lambe), type, right upper molar, NMC 6249, occlusal view.
B. *Peratherium valens* (Lambe), right M_2, ROM 1812, occlusal view.
C. Same specimen as in B, buccal view.
D. *Peratherium valens* (Lambe), right M_3, NMC 9126, occlusal view.
E. Same specimen as in D, buccal view.
F. *Nanodelphys*? *mcgrewi* sp. n., type, left upper molar, ROM 1814, occlusal view.
G. Cf. *Nanodelphys minutus* McGrew, left lower molar, ROM 6242, occlusal view.
H. *Ictops acutidens* Douglass, right M^2, ROM 1815, occlusal view.
I. *Ictops acutidens* Douglass, left M^2, ROM 6243, occlusal view.
J. *Ictops acutidens* Douglass, right M_3, ROM 1816, occlusal view.

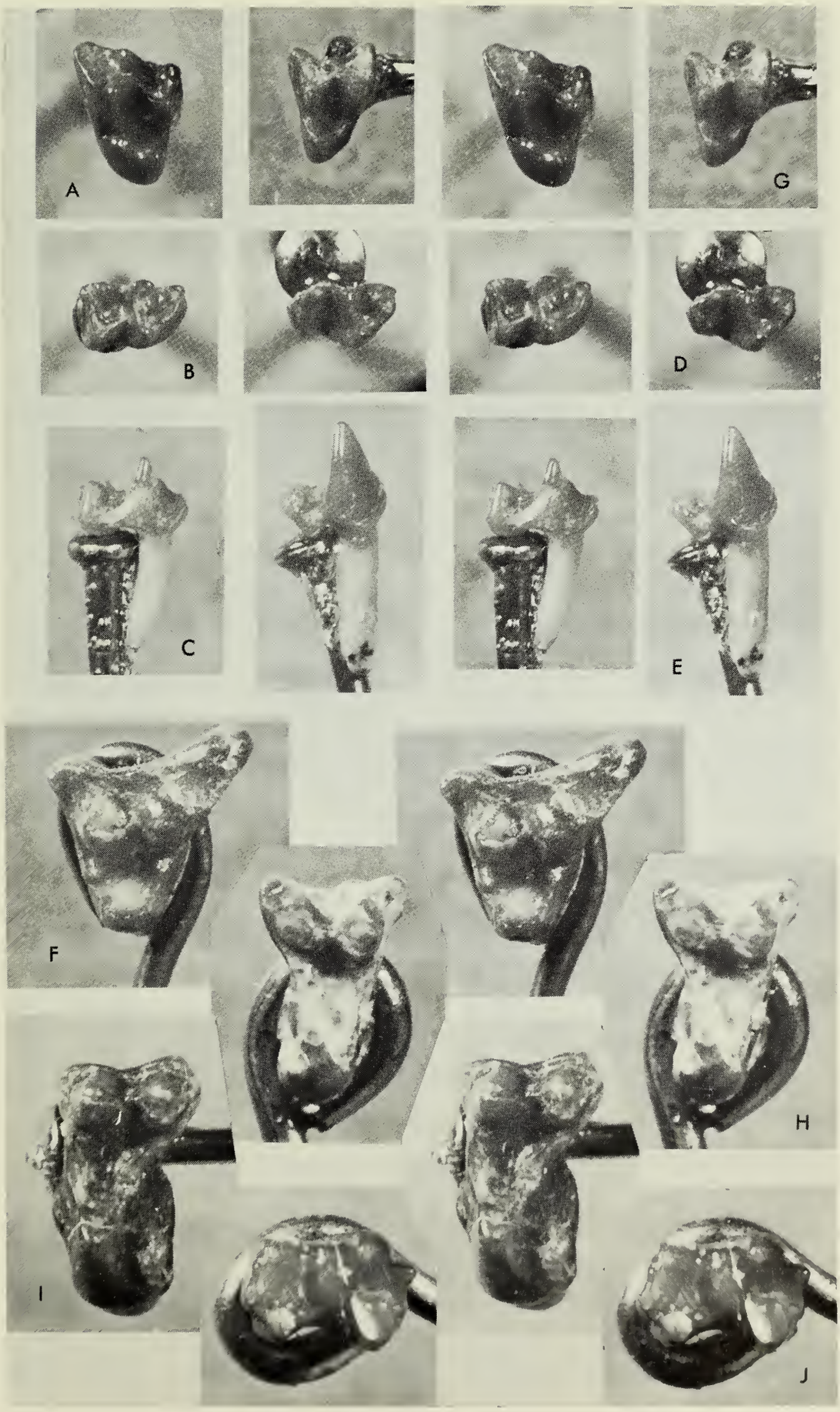
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Fig. 2: all ×8.

A. *Ictops acutidens* Douglass, right M_3, ROM 1816, buccal view.
B. *Ictops acutidens* Douglass, right M_3, ROM 6244, occlusal view.
C. Same specimen as in B, buccal view.
D. *Ictops acutidens* Douglass, left lower molar, ROM 6245, occlusal view.
E. Same specimen as in D, buccal view.
F. *Metacodon* cf. *magnus* Clark, incomplete left lower molar, ROM 6246, occlusal view.
G. Same specimen as in F, buccal view.
H. *Metacodon*? sp., left M_3, ROM 6374, occlusal view.
I. Same specimen as in H, buccal view.

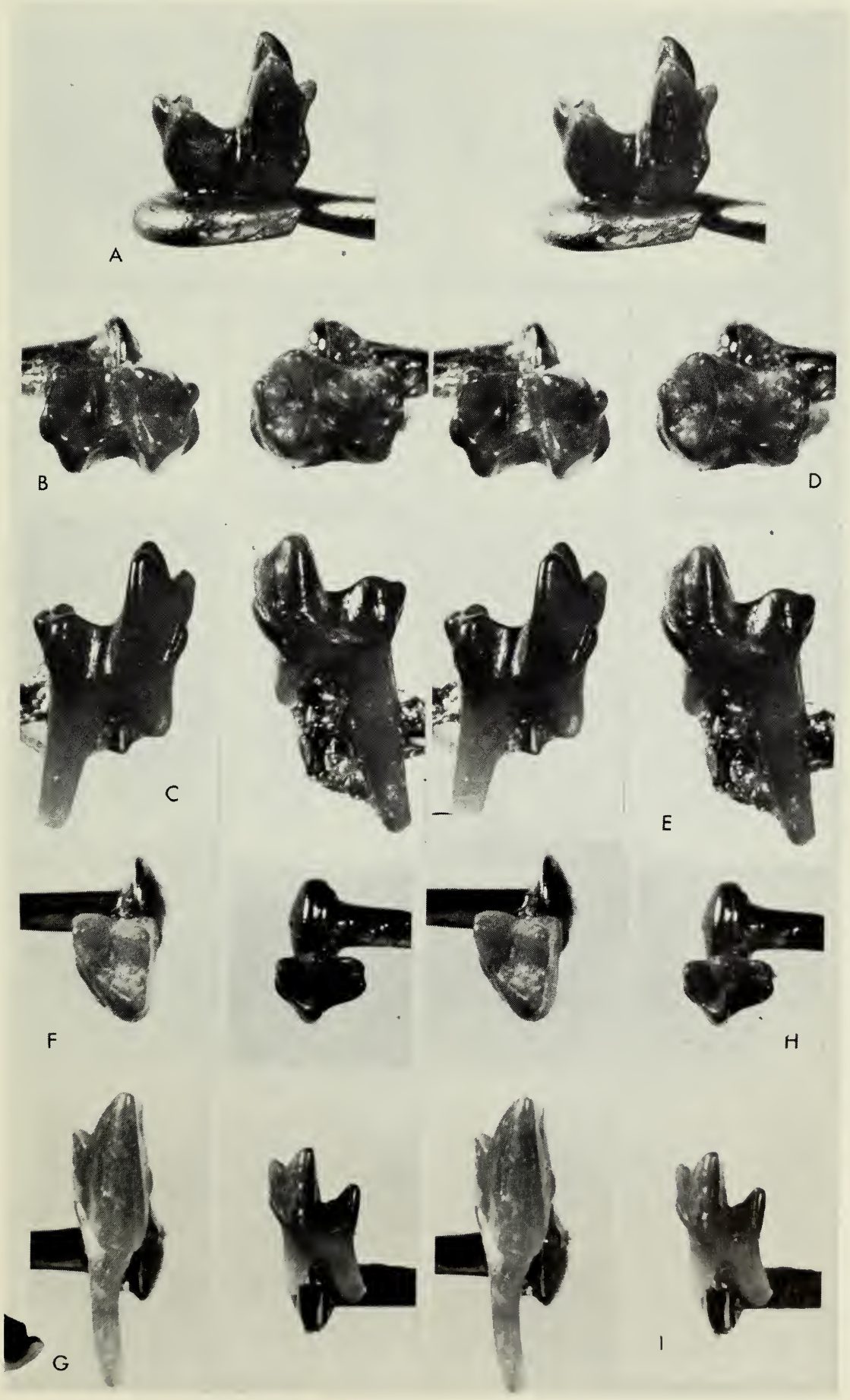
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Fig. 3: all ×8.

A. *Palaeolagus temnodon* Douglass, left P^3, NMC 9173, occlusal view.
B. *Palaeolagus temnodon* Douglass, left P^4, ROM 6264, occlusal view.
C. *Palaeolagus temnodon* Douglass, left M^1, ROM 6252, occlusal view.
D. *Palaeolagus temnodon* Douglass, right M^1, NMC 6486, occlusal view.
E. *Palaeolagus temnodon* Douglass, left M^2, ROM 6265, occlusal view.
F. *Palaeolagus temnodon* Douglass, right upper molar, NMC 9120, occlusal view.
G. *Palaeolagus temnodon* Douglass, left mandibular fragment with P_3 to M_1, NMC 9198, occlusal view.
H. Same specimen as in G, buccal view.

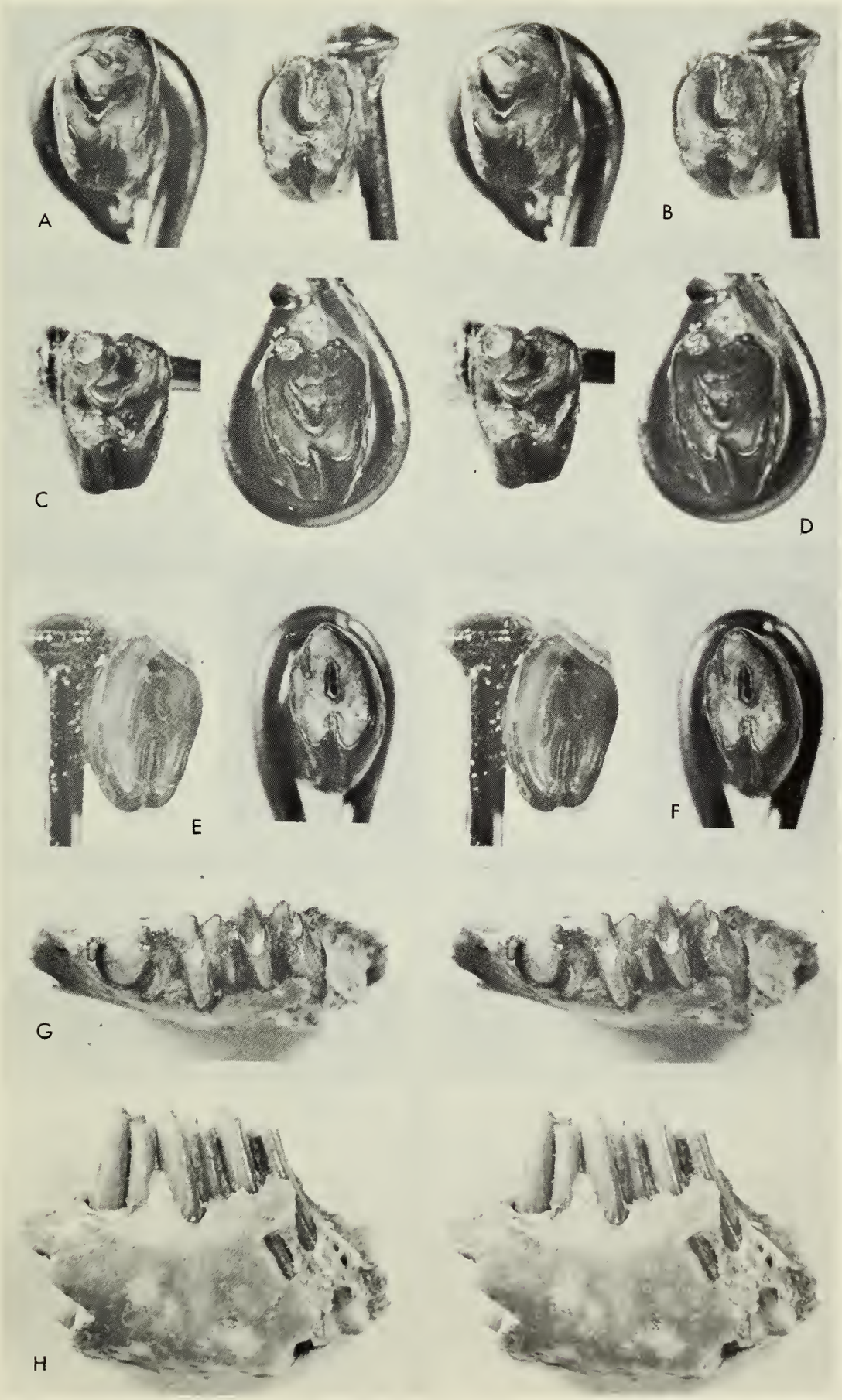
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Fig. 4: all ×8 except I.

A. *Palaeolagus temnodon* Douglass, right P_4, NMC 6485, occlusal view.
B. *Palaeolagus temnodon* Douglass, left DP_3, ROM 6257, occlusal view.
C. *Megalagus brachyodon* (Matthew), left P^4, ROM 7271, occlusal view.
D. *Megalagus brachyodon* (Matthew), left M^1, NMC 9180, occlusal view.
E. *Megalagus brachyodon* (Matthew), right M^1, ROM 6266, occlusal view.
F. *Megalagus brachyodon* (Matthew), left M^1, ROM 6267, occlusal view.
G. *Megalagus brachyodon* (Matthew), left M^1, NMC 9119, occlusal view.
H. *Megalagus brachyodon* (Matthew), right M^2, ROM 6274, occlusal view.
I. *Megalagus brachyodon* (Matthew), left mandibular fragment with P_4 to M_1, ROM 6376, buccal view, ×3.

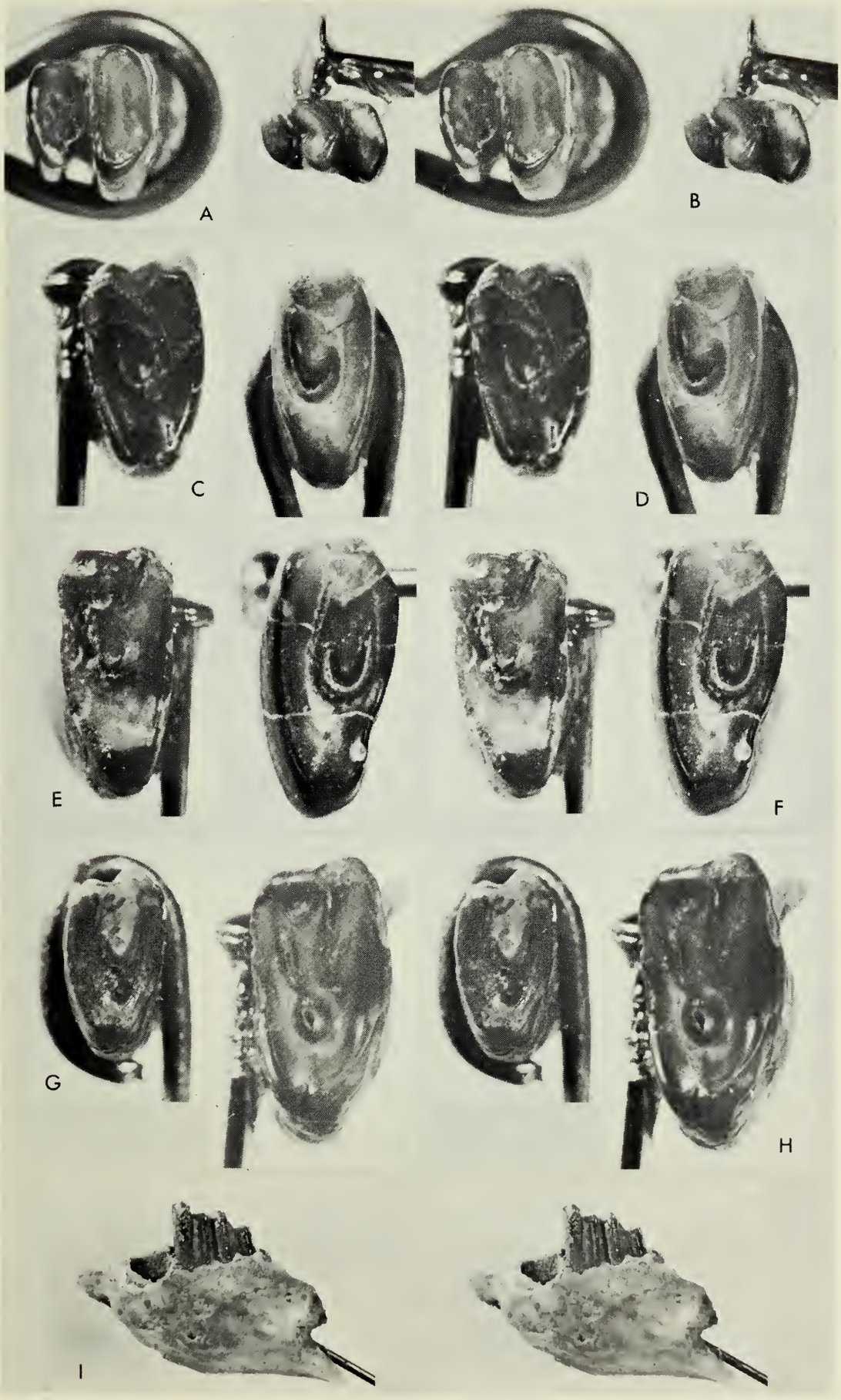
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Fig. 5: all ×8 unless otherwise indicated.

A. *Megalagus brachyodon* (Matthew), left P_4 to M_1, ROM 6376, occlusal view, ×4.
B. *Megalagus brachyodon* (Matthew), left P_3 to M_2, NMC 6483, occlusal view, ×4.
C. *Megalagus brachyodon* (Matthew), same specimen as in B, but showing entire mandibular fragment, buccal view, ×0.8.
D. *Prosciurus saskatchewensis* (Lambe), type, right P^4, NMC 6479, occlusal view.
E. *Prosciurus saskatchewensis* (Lambe), left P^4, ROM 6276, occlusal view.
F. *Prosciurus saskatchewensis* (Lambe), right M^1, NMC 9132, occlusal view.
G. *Prosciurus saskatchewensis* (Lambe), right M^1 or M^2, NMC 9170, occlusal view.
H. *Prosciurus saskatchewensis* (Lambe), left M^1 or M^2, ROM 6279, occlusal view.
I. *Prosciurus saskatchewensis* (Lambe), left M^1 or M^2, ROM 6280, occlusal view.

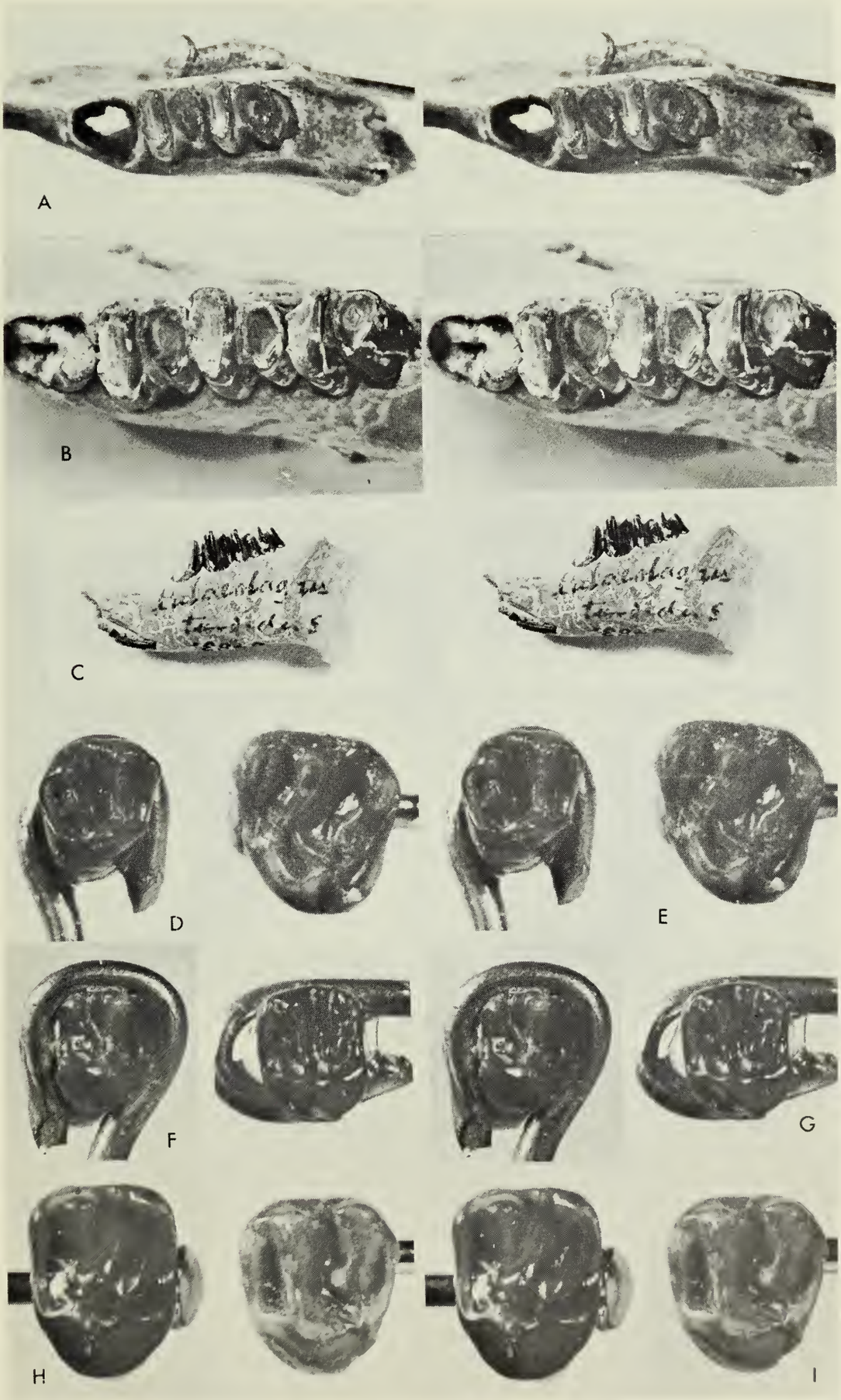
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Fig. 6: all ×8.

A. *Prosciurus saskatchewensis* (Lambe), right M^1 or M^2, ROM 6281, occlusal view.
B. *Prosciurus saskatchewensis* (Lambe), left $M^{2?}$, ROM 6277, occlusal view.
C. *Prosciurus saskatchewensis* (Lambe), right M^3, ROM 6282, occlusal view.
D. *Prosciurus saskatchewensis* (Lambe), right P_4, ROM 1822, occlusal view.
E. *Prosciurus saskatchewensis* (Lambe), left $M_{2?}$, ROM 1823, occlusal view.
F. *Prosciurus saskatchewensis* (Lambe), left $M_{2?}$ NMC 9133, occlusal view.
G. *Prosciurus saskatchewensis* (Lambe), right M_3, ROM 6278, occlusal view.
H. *Prosciurus minor* sp. n., type, right $M^{2?}$, ROM 6287, occlusal view.
I. *Prosciurus minor* sp. n., left M^2, ROM 6380, occlusal view.
J. *Prosciurus minor* sp. n., left M^3, ROM 6388, occlusal view.
K. *Prosciurus minor* sp. n., left M^3, ROM 6381, occlusal view.
L. *Prosciurus vetustus* Matthew, left P^4, ROM 1821, occlusal view.

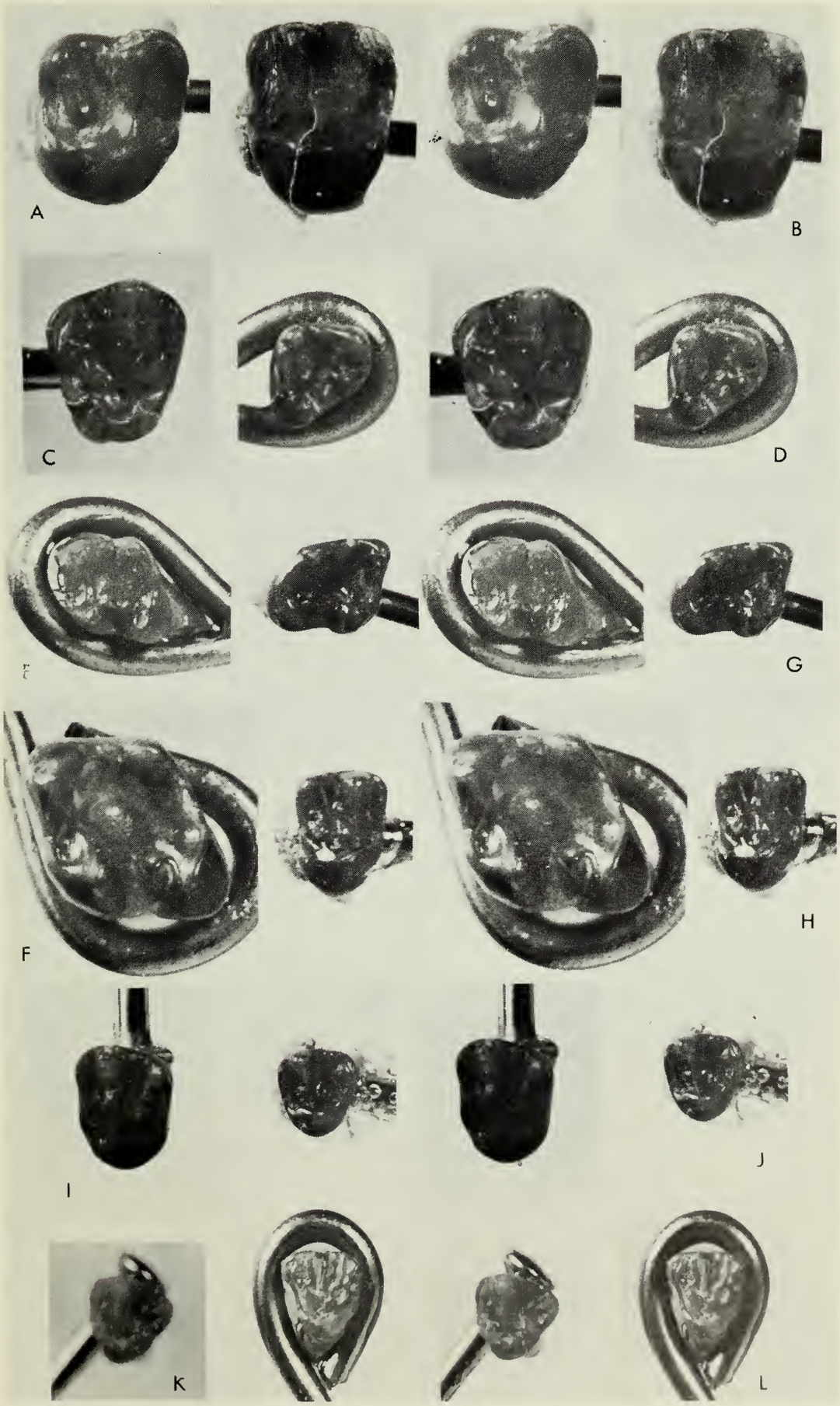
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Fig. 7: all ×8.

A. *Prosciurus vetustus* Matthew, right M^1, ROM 8283, occlusal view.
B. *Prosciurus major* sp. n., type, left M^1 or M^2, ROM 6377, occlusal view.
C. *Prosciurus major* sp. n., right P^4, ROM 6284, occlusal view.
D. *Prosciurus altidens s*p. n., type, right P^4, ROM 6285, occlusal view.
E. *Prosciurus altidens* sp. n., right M^1, ROM 6286, occlusal view.
F. *Prosciurus* sp., left P^4, ROM 2690, occlusal view.
G. *Prosciurus* sp., left upper molar, ROM 1819, occlusal view.
H. *Prosciurus* sp., left M^3, ROM 6289, occlusal view.
I. *Prosciurus* sp., left M^3, ROM 6379, occlusal view.
J. *Ischyromys junctus* sp. n., type, right M_2, NMC 9169, occlusal view.

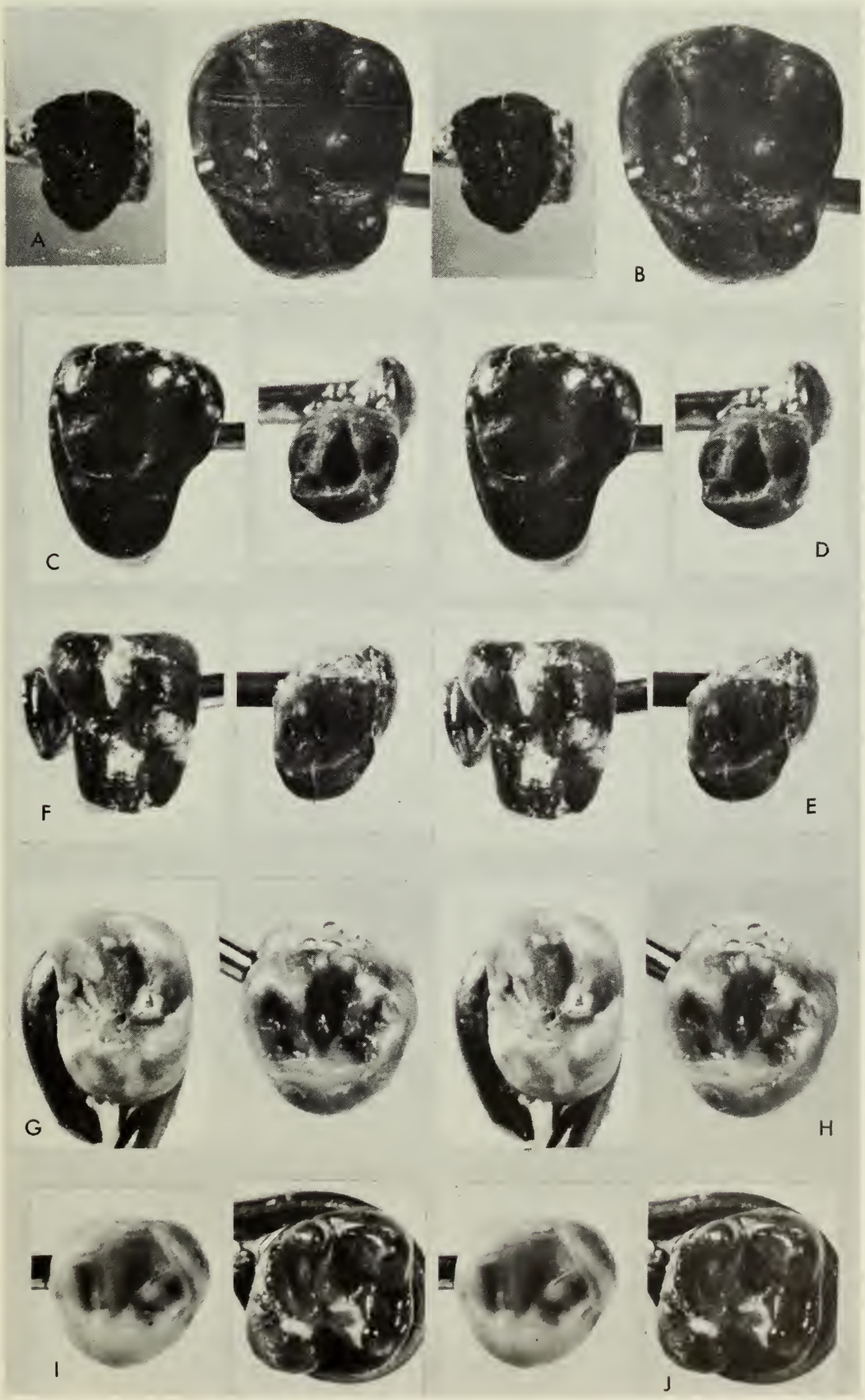
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Fig. 8: all ×8 except I.

A. *Ischyromys junctus* sp. n., right P_4, NMC 9131, occlusal view.
B. *Ischyromys junctus* sp. n., right P_4, ROM 6291, occlusal view.
C. *Ischyromys junctus* sp. n., right M_2, NMC 6480, occlusal view.
D. *Ischyromys junctus* sp. n., right M_3, ROM 6296, occlusal view.
E. *Ischyromys* sp., right upper molar, ROM 6298, occlusal view.
F. *Ischyromys* sp., left upper molar, ROM 6383, occlusal view.
G. *Ischyromys* sp., right upper molar, ROM 1835, occlusal view.
H. *Cylindrodon collinus* sp. n., type, right P_3 to M_3, NMC 9171, occlusal view.
I. *Cylindrodon collinus* sp. n., type, right mandibular ramus with I and P_3 to M_3, NMC 9171, buccal view, ×3.2.

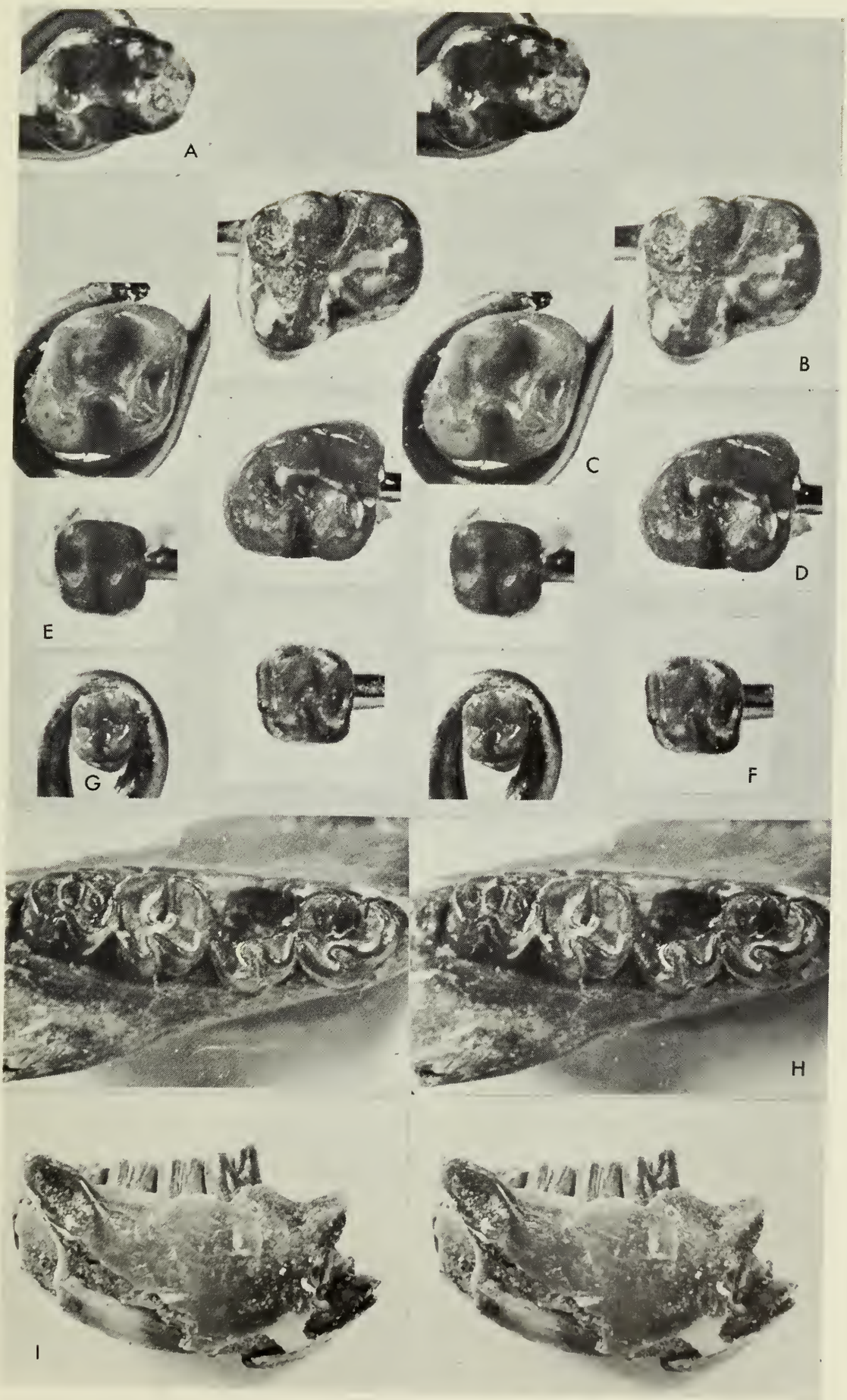
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Fig. 9: all ×8.

A. *Cylindrodon collinus* sp. n., right P^4, NMC 9372, occlusal view.
B. *Cylindrodon collinus* sp. n., left P^4, NMC 9137, occlusal view.
C. *Cylindrodon collinus* sp. n., left upper molar, NMC 9138, occlusal view.
D. *Cylindrodon collinus* sp. n., right M^1 or M^2, ROM 6305, occlusal view.
E. *Cylindrodon collinus* sp. n., right M_1 or M_2, ROM 6303, occlusal view.
F. *Eutypomys parvus* Lambe, type, right P_4, NMC 6482, occlusal view.
G. *Eutypomys parvus* Lambe, right M^1 or M^2, ROM 6311, occlusal view.
H. *Eutypomys parvus* Lambe, left M^1 or M^2, NMC 9197, occlusal view.
I. *Eutypomys parvus* Lambe, right M^1 or M^2, ROM 6314, occlusal view.
J. *Eutypomys parvus* Lambe, left M_1?, ROM 6312, occlusal view.
K. *Eutypomys parvus* Lambe, right M_1?, ROM 6313, occlusal view.

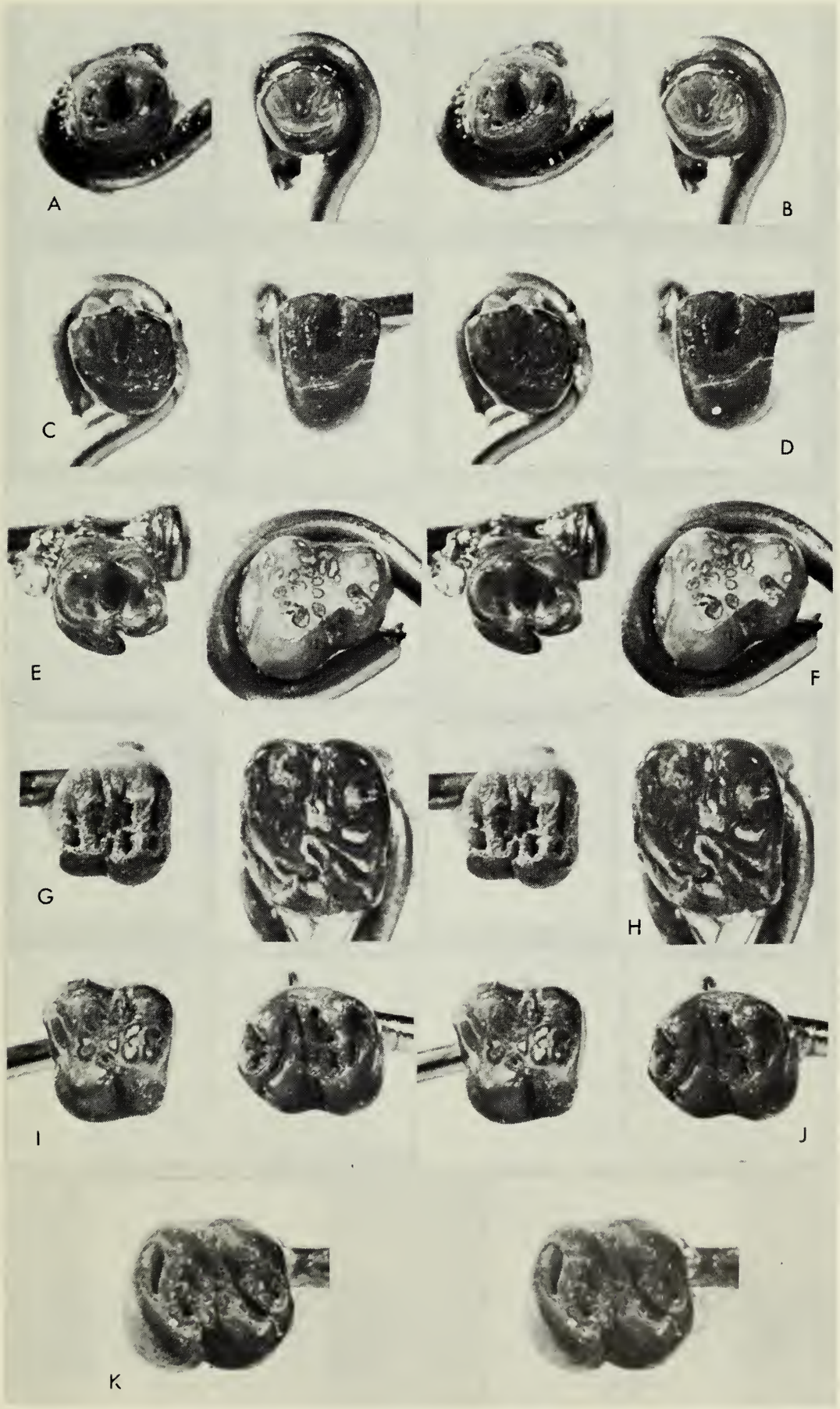
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Fig. 10: all ×8.

A. *Eutypomys* cf. *magnus* Wood, right P_4, ROM 6315, occlusal view.
B. *Eutypomys* cf. *magnus* Wood, left M_1 or M_2, ROM 6316, occlusal view.
C. *Adjidaumo stewarti* sp. n., type, left maxillary fragment with M^1 and M^2, ROM 6317, occlusal view.
D. *Adjidaumo stewarti* sp. n., right M^1 or M^2, ROM 1836, occlusal view.
E. *Adjidaumo hansonorum* sp. n., type, right M_1 or M_2, ROM 1827, occlusal view.
F. *Adjidaumo hansonorum* sp. n., right M^1 or M^2, ROM 6385, occlusal view.
G. *Adjidaumo hansonorum* sp. n., right P_4, ROM 6321, occlusal view.
H. *Adjidaumo hansonorum* sp. n., left M_3, ROM 6320, occlusal view.
I. *Adjidaumo hansonorum* sp. n., right DP_4, ROM 6323, occlusal view.
J. *Eumys pristinus* sp. n., type, right M^1, ROM 6324, occlusal view.
K. *Eumys pristinus* sp. n., left M^2, ROM 6325, occlusal view.

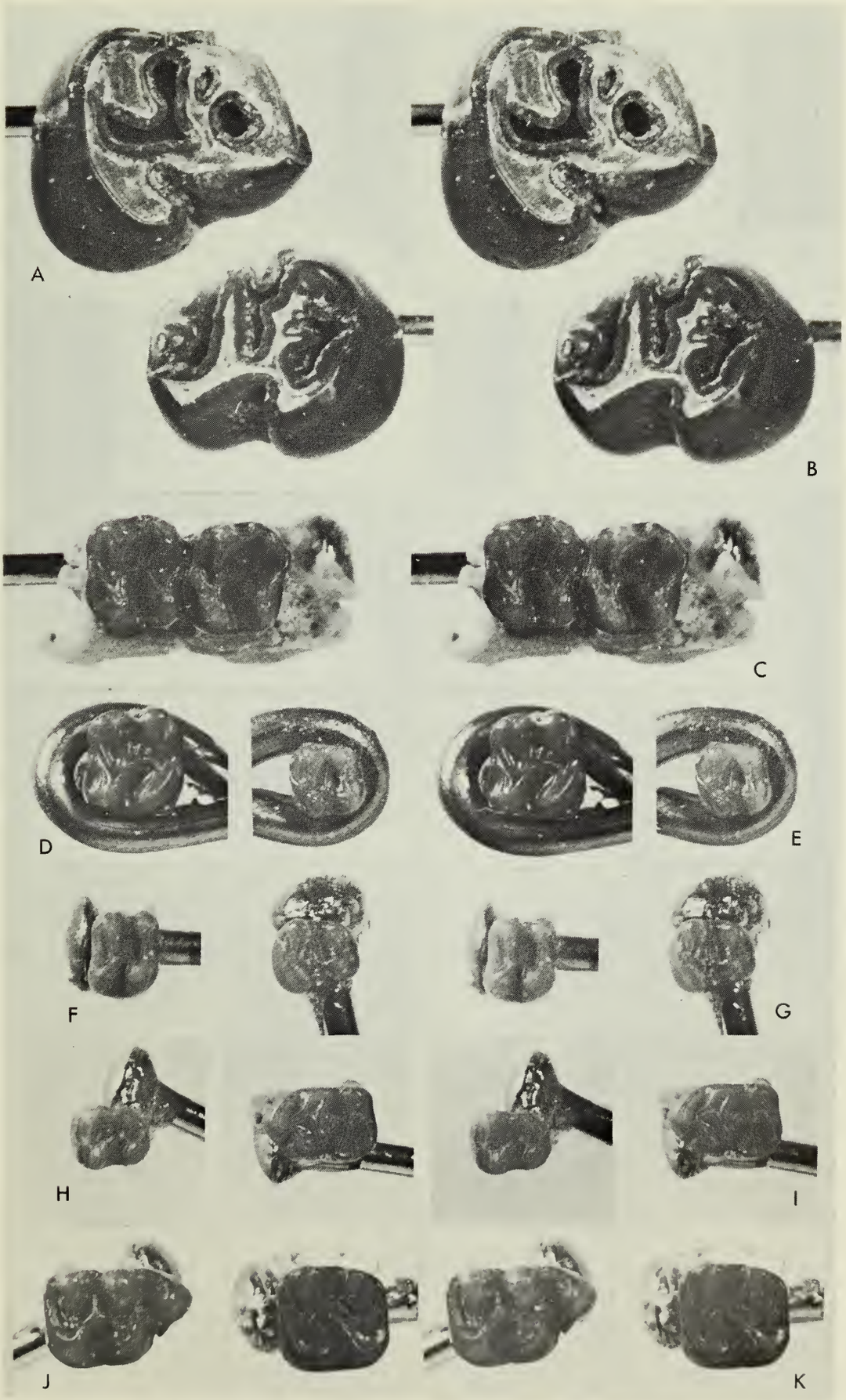
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Fig. 11: all ×8 unless otherwise indicated.

A. *Eumys pristinus* sp. n., left M^3, ROM 6326, occlusal view.
B. *Eumys pristinus* sp. n., left M^3, ROM 6327, occlusal view.
C. *Eumys pristinus* sp. n., left M_2, ROM 6328, occlusal view.
D. *Eumys pristinus* sp. n., right M_3, ROM 6330, occlusal view.
E. *Hyaenodon cruentus* Leidy, left M_1, NMC 8824, buccal view, ×1.6.
F. *Hyaenodon mustelinus* Scott, right DP^3, NMC 9199, occlusal view, ×3.2.
G. Same specimen as in F, buccal view, ×3.2.
H. *Hyaenodon mustelinus* Scott, left M^1, NMC 8640, occlusal view, ×3.2.
I. Same specimen as in H, buccal view, ×3.2.

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Fig. 12: scale as indicated.

A. *Daphoenus canadensis* Russell, type, right maxillary fragment with P^4, NMC 6512, occlusal view, ×0.8.
B. Same specimen as in A, buccal view, ×0.8.
C. *Daphoenus canadensis* Russell, right M_2, NMC 9206, occlusal view, ×3.2.
D. *Daphoenus lambei* Russell, type, left P^4, NMC 6513, occlusal view, ×2.4.
E. Same specimen as in D, buccal view, ×2.4.
F. *Daphoenus lambei* Russell, left M^1, NMC 9207, occlusal view, ×2.4.
G. *Daphoenus lambei* Russell, left M_1, NMC 9114, occlusal view, ×2.4.
H. Same specimen as in G, buccal view, ×2.4.

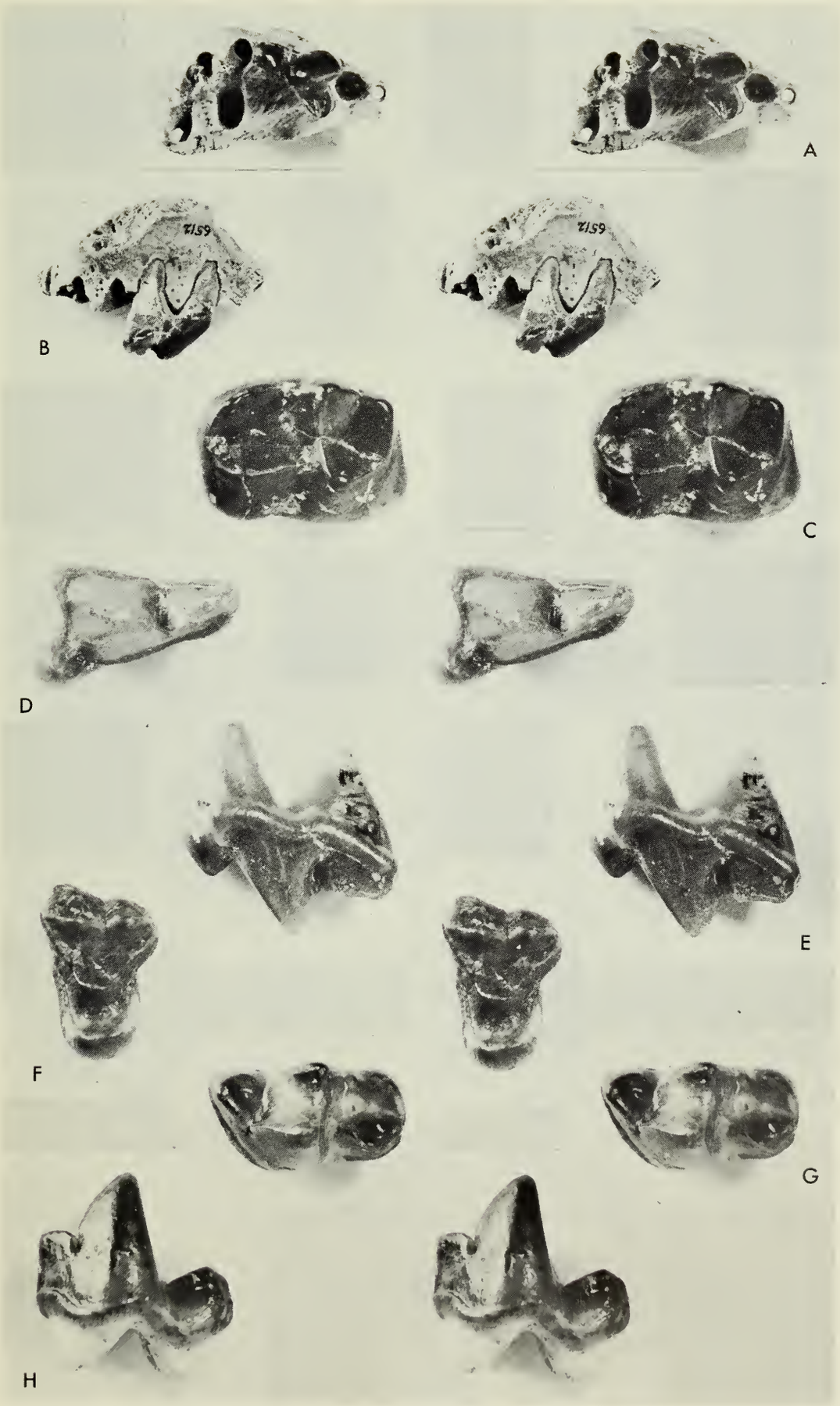
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Fig. 13: scale as indicated.

A. *Daphoenus* cf. *vetus* Leidy, left mandibular ramus with P_2 to M_2, NMC 9205, occlusal view, ×0.8.
B. Same specimen as in A, buccal view, ×0.8.
C. *Daphoenus* cf. *hartshornianus* (Cope), right P^4, ROM 6333, occlusal view, ×1.6.
D. Same specimen as in C, buccal view, ×1.6.
E. *Daphoenus* sp., left M^1, ROM 6332, occlusal view, ×3.2.
F. Cf. *Hyaenodon*? *minutus* Douglass, right M^2, NMC 9353, occlusal view, ×3.2.
G. Same specimen as in F, buccal view, ×3.2.
H. *Hesperocyon gregarius* (Cope), right P^4, NMC 9201, occlusal view, ×3.2.
I. Same specimen as in H, buccal view, ×3.2.

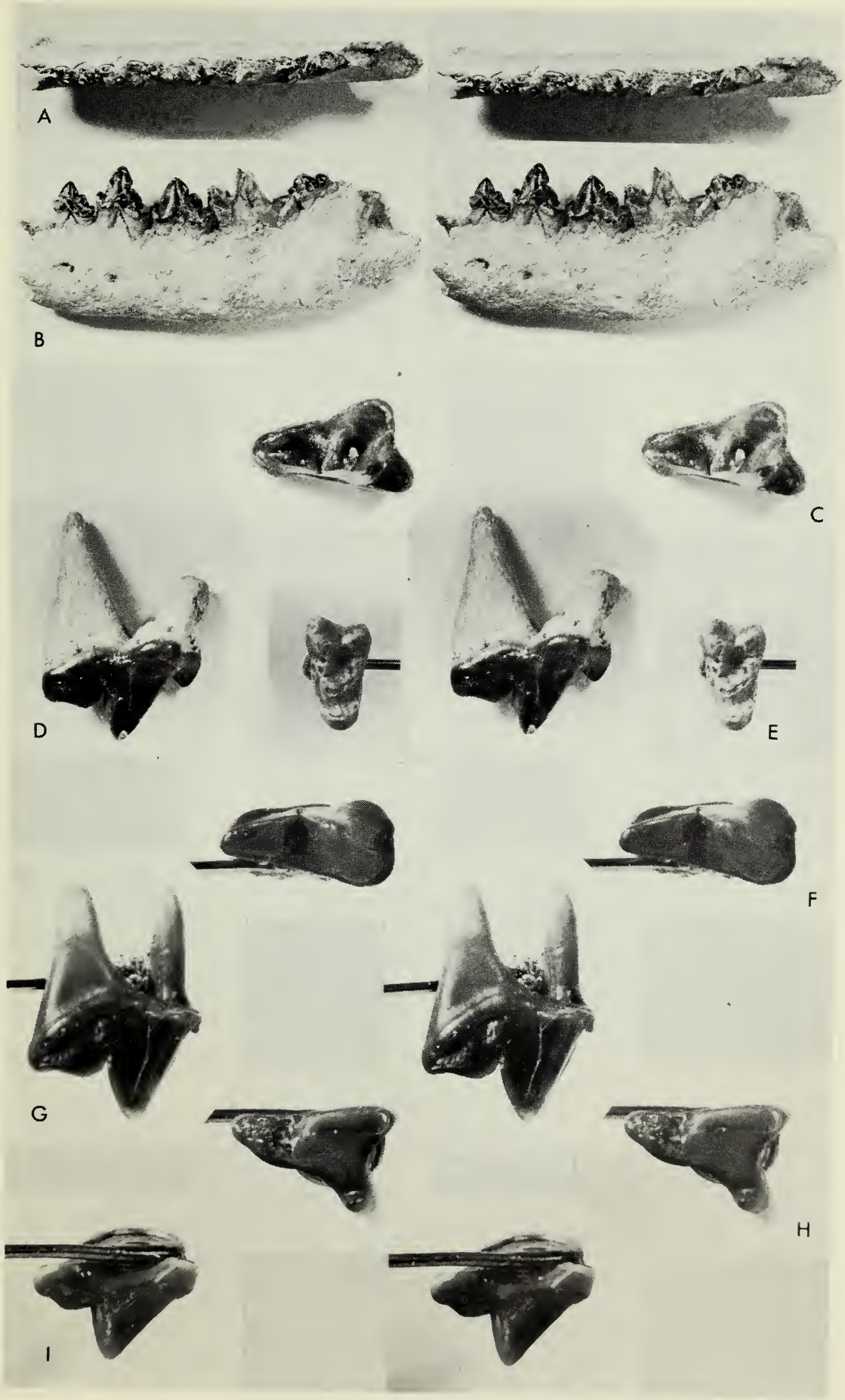
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Fig. 14: all ×3.2.

A. *Hesperocyon gregarius* (Cope), right P^4, ROM 6334, occlusal view.
B. Same specimen as in A, lingual view.
C. *Hesperocyon gregarius* (Cope), right M^1, NMC 9127, occlusal view.
D. *Hesperocyon gregarius* (Cope), right M^1, NMC 9128, occlusal view.
E. *Hesperocyon gregarius* (Cope), left M^1, ROM 6338, occlusal view.
F. *Hesperocyon gregarius* (Cope), right M^2, ROM 1818, occlusal view.
G. *Hesperocyon gregarius* (Cope), right M^2, ROM 6339, occlusal view.
H. *Hesperocyon gregarius* (Cope), left P_3, NMC 6501, buccal view.
I. *Hesperocyon gregarius* (Cope), left P_3, NMC 6503, buccal view.
J. *Hesperocyon gregarius* (Cope), left P_4, NMC 6502, buccal view.

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Fig. 15: all ×3.2, except H.

A. *Hesperocyon gregarius* (Cope), right M_1, ROM 6388, buccal view.
B. Same specimen as in A, occlusal view.
C. *Hesperocyon gregarius* (Cope), left M_1, ROM 6342, buccal view.
D. Same specimen as in C, occlusal view.
E. *Hesperocyon gregarius* (Cope), right M_1, ROM 6341, buccal view.
F. Same specimen as in E, occlusal view.
G. *Hesperocyon gregarius* (Cope), right M_2, NMC 9202, occlusal view.
H. Same specimen as in G; buccal view of right mandibular fragment with M_2, ×0.8.

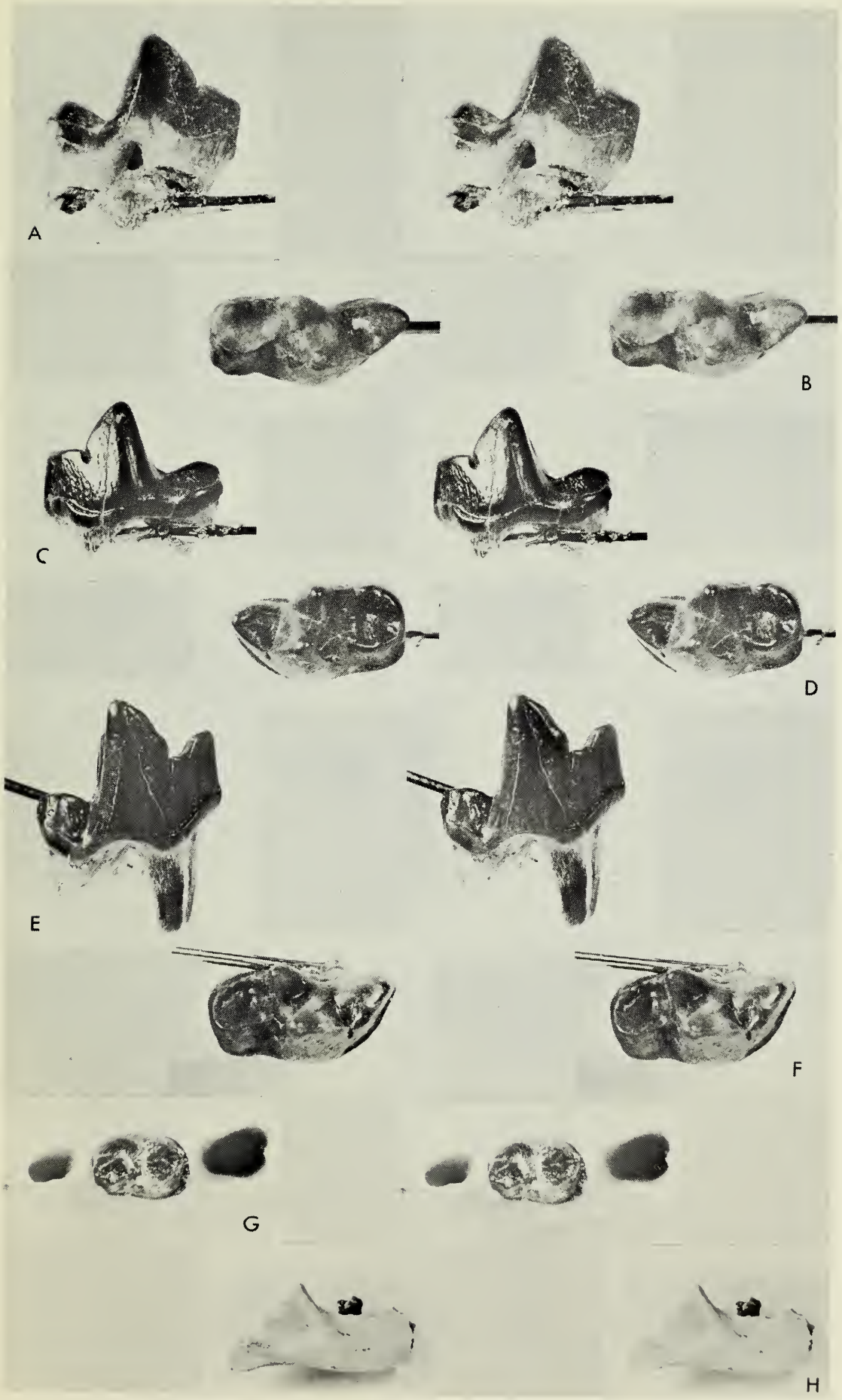
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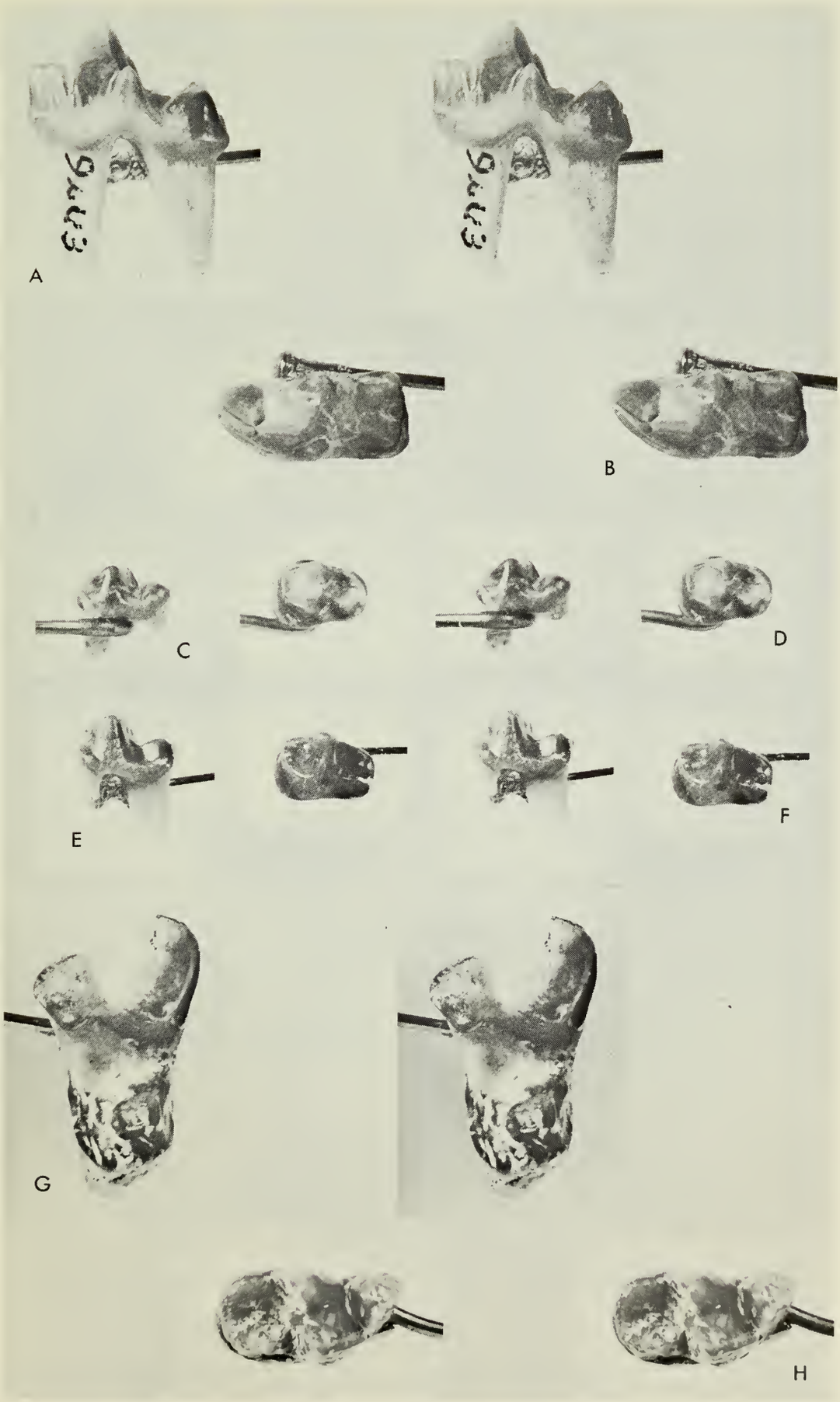
Fig. 16: all ×3.2.

A. *Hesperocyon gregarius* (Cope), left M_1, NMC 9203, buccal view.
B. Same specimen as in A, occlusal view.
C. *Hesperocyon gregarius* (Cope), left M_2, NMC 9130, buccal view.
D. Same specimen as in C, occlusal view.
E. *Hesperocyon gregarius* (Cope), left M_2, ROM 6344, buccal view.
F. Same specimen as in E, occlusal view.
G. *Hesperocyon* sp., right M^1, ROM 6347, occlusal view.
H. *Hesperocyon* sp., right M_1, NMC 9129, occlusal view.


A
B
C
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E
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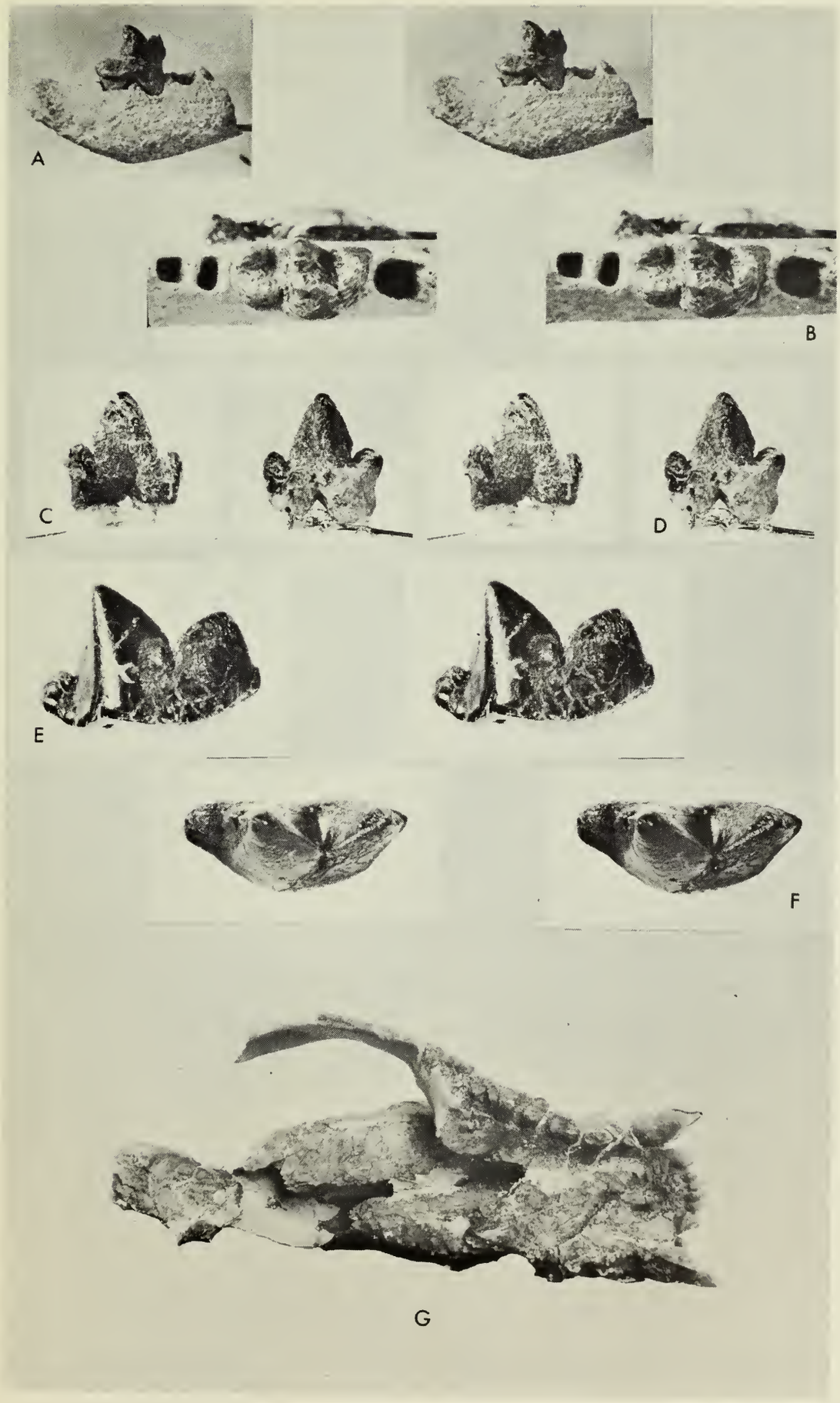
G
H

Fig. 17: scale as indicated.

A. *Daphoenocyon*? sp., right mandibular fragment with M_1, ROM 6348, buccal view, ×1.6.
B. Same specimen as in A, occlusal view of M_1, ×3.2.
C. *Dinictis felina* Leidy, right lower premolar, NMC 9355, buccal view, ×1.6.
D. Same specimen as in C, lingual view, ×1.6.
E. *Dinictis felina* Leidy, right M_1, NMC 6475, buccal view, ×1.6.
F. Same specimen as in E, occlusal view, ×1.6.
G. *Hemipsalodon grandis* Cope, incomplete skull, NMC 8791, palatal view, ×0.2.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